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In re Application of:)
VARRIANO-MARSTON, Elizabeth) Group Art Unit: 1772
Serial No. 09/877,757) Examiner: Patterson, Marc
Filed: 06/08/2001) Appeal No.
Atty. Dkt. No: MARS93-DIV)

For: REGISTERED MICROPERFORATED FILMS FOR MODIFIED/CONTROLLED ATMOSPHERE PACKAGING

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Debra A. Stengel

Date: 11/04/2004 [✓] Debra A. Stengel ~~or [ ] Scott J. Asmus, Reg. No. 42,269~~

APPEAL BRIEF TRANSMITTAL

Transmitted herewith for filing is an APPEAL BRIEF for the above-identified application. The requisite fee set forth in 37 CFR §41.20(b2) and 37 CFR §1.136(a) accompanies this brief (small entity) in PTO Form 2038. As this brief is filed after Sept. 13, 2004, Applicant adheres to the 37 C.F.R. §41.37 and only a single copy of the Brief is provided.

[X] DEPOSIT ACCOUNT 500323 AUTHORIZATION - All necessary fees relating to the attached submittal, if any, are intended to be included. However, the Office is hereby authorized to charge any deficiency or credit any overpayment in the fees relating to the submittal to deposit account 500323, registered to Vernon C. Maine P.L.L.C., dba Maine & Asmus, contact telephone no. 603-886-6100.

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Respectfully submitted,

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APPEAL BRIEF

This is an Appeal from the final rejection of the Examiner dated 6/4/2004, the subsequent Advisory Action dated 8/27/2004, and the Notice of Appeal filed 8/6/2004. Claims 1-4, 6-12, 14, 21 and 22 are currently pending in this case. The requisite fee set forth in 37 CFR §41.20(b2) and 37 CFR §1.136(a) accompanies this brief (small entity) in PTO Form 2038 (Deposit Account No. 500323 authorized for any credit or deficiency).

As this brief is filed after Sept. 13, 2004, Applicant adheres to the 37 C.F.R. §41.37 and only a single copy of the Brief is provided.

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02 FC:2252 55.00 OP

REAL PARTY IN INTEREST (37 CFR §41.37(c))

Inventor Elizabeth Varriano-Marston is the inventor and applicant, and as such is the real party in interest.

RELATED APPEALS AND INTERFERENCES (37 CFR §41.37(c))

There are no other co-pending applications or appeals that need to be considered by the Board in this case. There are two issued U.S. Patents – U.S. Pat. No 6,441,340; and U.S. Pat. No. 6,730,874.

STATUS OF CLAIMS (37 CFR §41.37(c))

Claims 1-4, 6-12, 14, 21 and 22 are pending; claims 15-20 were withdrawn and claims 5, 13 were cancelled.

This Appeal is taken from the final rejection of claims 1-4, 6-12, 14, 21 and 22.

STATUS OF AMENDMENTS (37 CFR §41.37(c))

As the prosecution history is lengthy, Applicant respectfully requests that the Board consider the present file history in its entirety wherein the responses are incorporated by reference. An outline of the interactions prior to the final action and subsequent to the final action is provided herein for convenience. The various responses include lengthy explanations and descriptions to teach the state of the art, distinguish the claimed invention, and are replete with supporting materials that demonstrate the distinctions, show commercial success, testimonials of the unexpected test results, and inventor declarations. Due to the long file history the Applicant has provided this Outline for the convenience of the Board in two sections, namely an outline prior to the last final rejection and an outline after the last final rejection.

FILE WRAPPER OUTLINE PRIOR TO LAST FINAL REJECTION

Application Filed 6/18/2001

The pending claims originate from the divisional Application filed on 6/8/2001 with 20 claims including 2 independent claims.

Office Action dated 7/18/2002

A non-final action was mailed 7/18/2002 and rejected the elected claims 1-14 under 35 U.S.C §112; Claims 1-3, 5-12 and 14 were rejected under 35 U.S.C §102 by U.S. Pat. No. 6,010,293 (DeMoor); and Claim 13 was rejected under 35 U.S.C §103 by DeMoor in view of U.S. Pat. No. 6,376,032 (Clark). On or about June 20, 2002, Applicant had made a telephone election for claims 1 – 14 and claims 15-20 were withdrawn from consideration.

Office Action Response filed 10/18/2002

A non-final response was filed 10/18/2002 in response to the non-final action dated 7/18/2002 including a Rule 132 Declaration and Exhibits A-J, Letters 1-5 and five articles to aid in the understanding of the subject matter of the invention. The Exhibits included existing perforated films and the registered target microperforations in the film of the present invention. Test data and actual results were included therein. Claims 2, 10, 11, 13, and 14 were amended; claims 15 – 20 were canceled; and new claims 21 and 22 were added.

Office Action dated 1/3/2003

A non-final action was mailed 1/3/2003 withdrawing the 35 U.S.C §112 rejections for claims 1-3, 7, and 13-14; withdrawing 35 U.S.C §102 rejection of claims 1-3, 5-12, and 14; and withdrawing 35 U.S.C §103 rejection of claim 4. Rejections under 35 U.S.C §112 for claims 5-6 and 9 were repeated. New rejections were introduced for claims 1-14 under 35 USC 112; and claims 1-3, 5-12, 14 and 21-22 were rejected under 35 U.S.C §103 over U.S. Pat. No. 6,010,293 (DeMoor) in view of U.S. Pat. No. 5,258,156 (Kurachi).

Telephone Interview 1/29/2003

A telephone interview was conducted on 1/29/2003 and it was explained that microporous materials were distinguishable from microperforations and agreed to amend claim 1 to describe microperforations as 'drill holes' in order to distinguish the microporous art.

Office Action Response filed 1/30/2003

A non-final response was filed on 1/30/2003 in response to the non-final action dated 1/3/2003. Claims 1, 8, 10, 11, and 12 were amended. Supplemental IDS's were filed 2/5/2003 and 2/27/2003.

Office Action dated 5/15/2003

A final rejection was mailed 5/15/2003 withdrawing 35 U.S.C §112 rejection for claims 1-9 and 12-14; withdrawing 35 U.S.C §102 rejection of claims 1-3, 5-12, 14 and 21-22; withdrawing 35 U.S.C §103 rejection of claims 1-3, 4,-14 and 21-22. The rejection of claims 10-11 under 35 U.S.C 112 was repeated; new rejections under 35 U.S.C §102 were provided for claims 1-4, 8-9, 12-13 and 21 as being anticipated by U.S. Pat. No. 5,919,547 (Kocher); Claims 5-6, 14 and 22 were rejected under 35 U.S.C §103 by Kocher; Claim 7 was rejected by Kocher in view of U.S. Pat. No. 5,919,547 (Porchia)

Office Action Response filed 7/9/2003

In response to the final office action dated 5/15/2003, Applicant filed an After Final Response on 7/9/2003 and a Supplement on 7/28/2003. The After-Final Response amended claims 1, 10, and 11.

Advisory Action dated 7/30/2003

An Advisory Action was mailed on 7/30/2003 stating new matter was introduced in the After Final Response dated 5/15/2003. Subsequent telephone discussions with the Examiner were initiated.

Request for Continued Examination (RCE) filed 8/15/2003

Request for Continued Examination (RCE) was filed on 8/15/2003, thereby entering the After Final Response dated 5/15/2003 and also further amending claims 1, 10, and 11.

Office Action dated 12/3/2003

A non-final Office Action was mailed on 12/3/2003, withdrawing the 35 U.S.C §112 rejection of claims 10-11. New rejections were set forth, including a rejection based on 35 U.S.C §102 for claims 1-4, 8-9, 12-13 and 21 as being anticipated by U.S. Pat. No. 5,919,547 (Kocher); Claims 5-6, 14 and 22 were rejected based on Kocher; Claims 7 and 10-11 were rejected by Kocher in view of U.S. Pat. No. 5,492,705 (Porchia).

Telephone Interview 2/27/2004

A telephone interview was conducted on 2/27/2004 and Applicant agreed to amend claims per the interview.

Office Action Response filed 3/1/2004

A non-final office action response was filed 3/1/2004 in response to the office action dated 12/3/2003, and Claim 1 was amended.

FILE WRAPPER OUTLINE SUBSEQUENT TO LAST FINAL REJECTION

Office Action dated 6/4/2004

A final office action was mailed 6/04/2004 withdrawing the 35 U.S.C §102 rejections of claims 1-4, 8-9, 12-13 and 21; withdrawing the 35 U.S.C §103 rejections of claims 5-7, 10-11, 14 and 22. New rejections were provided rejecting claims 1-4, 8-9, 12-13 and 21 as being anticipated by U.S. Pat. No. 4,886,372 (Greengrass). Claims 2-4, 9, 12-13 and 21 were rejected under 35 USC §103 by Greengrass in view of U.S. Pat. No. 5,919,547 (Kocher). Claims 7 and 10-11 were rejected under 35 U.S.C §103 by Greengrass in view of Kocher and further in view of U.S. Pat. No. 5,492,705 (Porchia).

Personal Interview held 7/29/2004

On July 29, 2004 a personal interview between Examiner Patterson, Inventor/Applicant Marston and Attorney Asmus was conducted in which the inventor showed examples of packaging and demonstrated the environmental state of the various packaging environments in relation to the present invention. More specifically, the experimentation demonstrated that

Greengrass does not function according to some of the stated objectives. As noted in the Interview Summary, it was agreed to amend claim 1 in relation to microperforation hole size, flux rate provided by the microperforations and registered target area, and to provide a declaration in support therewith to distinguish the present invention. An agreement was not reached and the Examiner was uncertain whether the amendments in relation to the placement of the microperforations would require a new search or be considered a new issue. (Interview Summary 7/29/2004)

Office Action Response filed 8/6/2004

On 8/6/2004 the Applicant filed an After-Final Response including arguments, Inventor Declaration and supporting technical materials along with a Notice of Appeal and the prescribed fee. The After-Final Response amended claim 1, 10, and 11; canceled claims 5 and 13, and submitted arguments in support of allowance along with the inventor declaration in relation to Greengrass.

Advisory Action dated 8/27/2004

The Examiner entered the proposed amendments and maintained the rejection of all pending claims. The anticipation rejection under 35 U.S.C §102 was withdrawn for claims 1-4, 9, 12, and 21. A new rejection under 35 U.S.C. §103 was set forth for claims 1-4, 6, 8-9, 12, 14 and 21-22 as being unpatentable over U.S. Pat. No. 4,886,372 (Greengrass) in view of U.S. Pat. No. 5,919,547 (Kocher). Claims 7 and 10-11 were rejected under 35 U.S.C. §103 as being unpatentable over Greengrass in view of Kocher and further in view of U.S. Pat. No. 5,492,705 (Porchia)

SUMMARY OF CLAIMED SUBJECT MATTER (37 C.F.R. 41.37(c))

The present invention relates to packaging material for respiring or biochemically active agricultural products such as fresh fruits, fresh vegetables, fresh herbs, and flowers (herein referred to collectively fresh produce). (see Marston Application - Technical Field of the Invention, Page 1, lines 13-17)

The goal in fresh fruit and vegetable packaging is to preserve produce quality by reducing the aerobic respiration rate but avoiding anaerobic processes that lead to adverse changes in texture, flavor, and aroma, as well as public health concerns. And, the industry is continually trying to improve the practical mechanisms to achieve the above-stated goal. Modified atmosphere packaging (MAP) and controlled atmosphere packaging (CAP) refer to known methods to control the atmosphere in the package, and the packaging field includes the use of non-barrier (often referred to in the industry as "breathable") materials. And, there have been attempts to optimize the packaging for the fresh produce, including breathable microporous patches and microperforated packaging. (see Marston Application – Background of the Invention page 1, lines 21-30; page 2, lines 9-20)

While those in the packaging industry tried to improve the packaging for fresh produce, the prior efforts did not produce a packaging material according to the elements of Independent Claim 1. There are several elements of the claimed invention that distinguish it from all the prior references and state of the art taken alone or in combination. The present invention describes, in a fully enabling manner, a packaging product that has a set of microperforations establishing the optimal atmospheric condition for a given produce. Based on the number and the size of the microperforations, they control and maintain the optimum atmospheric conditions within specified O_2 and CO_2 concentrations for each specific respiring produce type and weight. The microperforations establish the desired film gas transmission rates and gas flux for the specific produce item. (Marston Application – Example 1 – 6, pages 21-30) Furthermore, the present invention actually deploys the microperforations in a registered target area instead of incorporating microperforations throughout the packaging.

The respiration rate of the produce is matched to the gas transmission rate of the base film and the oxygen flux rates provided by the size and number of microperforations in the film to establish an optimum equilibrium atmosphere inside the package that is conducive to reduced respiration rates and shelf life extension. There are no cited references that teach a produce packaging that provide the claimed features of the present invention defining the flow rate or the relationship of the atmosphere to the number/size of holes. (Marston Application; page 19, lines

29-31; page 20, lines 24-29; see Examples 1-6, pages 21-30) The microperforations are also placed in a registered target area on the polymeric material, such that the location is intended to avoid occlusion by adjacent packages or by produce inside the bag. (see Marston Application Fig. 2)

As described in the present application, the produce packaging employs microperforations wherein the size and number of microperforations are optimally selected to obtain the desired film gas transmission rates and gas flux for maintaining the quality of that specific produce item and the microperforations are within a size range and located in a target area. Marston Figures 2 and 4 shows a bag formed from the non-porous polymeric material with drill holes 100 situated in a finite region determined to avoid occlusion. The size/number of the microperforations control and maintain the atmospheric condition in the bag within specified O_2 and CO_2 concentrations as articulated in the claims. The microperforations are placed in a registered target area to avoid occlusion. (Marston Application – page 16, lines 5-15)

None of the cited references describes the use of certain size/number of microperforations establishing a specified flux rate in a registered target area. Most state of the art microperforated packaging employs a 'one size fits all' approach wherein the size/number of the microperforations are generally not calculated to satisfy the requirements for a particular produce item nor the weight of the item. There is reference to empirical 'trial and error' to improve packaging, but no other reference established the relationship between the produce and the packaging such that the microperforations of a certain size range establish the atmospheric conditions for optimal storage for a specific flux rate. In addition, in the cited references, the microperforations are typically distributed throughout the packaging and are not in a small target area. The Examiner has failed to provide <u>objective</u> criteria for establishing obviousness and imparts the limitations of the claims into the cited art without a solid foundation.

Independent Claim 1

With respect to the only Independent claim, claim 1 recites:

- a non-porous polymeric material; (Marston Application, Fig.1 ref # 40; Marston Application pages 17, lines 5-11)
- a set of microperforations on said polymeric material, wherein said set of microperforations are drill holes and (Marston Fig.1 ref # 100)
- based on a number and a size of said microperforations, control and maintain said optimum atmospheric conditions within specified O_2 and CO_2 concentrations for said respiring produce, (Marston Application; page 19, lines 29-31; page 20, lines 24-29; see Examples 1-6, pages 21-30)
- said optimum atmospheric conditions containing less than about 20.9% O_2 and greater than about 0.03% CO_2, (Marston Application Page 5, line 1; Marston Application Page 21, Example 1 lines 7-30; Page 8, lines 1-25)
- wherein said polymeric material provides a total O_2 Flux ranging from 150 cc/day-atm to 5,000,000 cc/day-atm and (Marston Application Page 20, lines 24-29)
- wherein each of said microperforations has an average diameter between 110 and 400 microns and (Marston Application Page 19, lines 29-31; Fig. 1 ref # 100)
- said set of microperforations are placed in a registered target area on said polymeric material, said registered target area being a finite region on said polymeric material. (Marston Application Page 16, lines 5-15; Fig. 2 ref # 50)

The present invention specifically articulates that the microperforations (Marston Application - Fig. 2 item 100) are drill holes in the non-porous polymeric materials (Marston Application Fig. 1 item 40). The number and size of the microperforations (Marston Application – Fig. 2 item 100) are used to control and maintain the optimum atmospheric conditions within the package for the particular produce. (Marston Application – Fig. 6 and Fig. 7). The optimum atmospheric conditions within the package being less than about 20.9% O_2 and greater than about 0.03% CO_2. An oxygen flux rate is further depicted and ranges from 150 cc/day-atm to 5,000,000 cc/day-atm. (Marston Application – page 20, lines 24-29) Each of the

microperforations is further claimed as having an average diameter between 110 and 400 microns. (Marston Application page 19, lines 29-31) Finally, the microperforations are placed in a registered target area (Marston Application - Fig. 2 item 50) which is a finite region on the packaging intended to avoid occlusion.

Dependent Claim 6

Dependent claim 6 recites:

The improved packaging material according to claim 1, wherein said polymeric material provides a total O_2 Flux ranging from 200 cc/day-atm to 1,500,000 cc/day-atm.

This range of the O_2 Flux represents the range for most produce with a weight that varies up to several thousand kg. (Marston Application page 20, lines 24-29) As described herein, the cited references do not recite any comparable range for any such flux – nor would it be readily apparent as they do not appreciate the impact of the atmosphere in the package and the relationship to the produce variables.

Dependent Claim 10

Dependent claim 10 recites:

The improved packaging material according to claim 7, wherein the bag is substantially enclosed with a top seal, a bottom seal, and a pair of side seals, and wherein the registered target area is within one-quarter distance from the top seal of the bag. (Marston Application Page 16, lines 5-15; Marston Application Fig. 2 ref #50)

Independent claim 1 claims the microperforations in a finite region termed a registered target area. The dependent claim 10 specifically claims the location of the finite region on the bag being located within one-quarter distance from the top seal. There is no reference in any of the cited art to a location for the target area.

The region on the bag is shown in Marston Fig. 2 and the application teaches that the registered target area is in a specific portion of the bag to avoid occlusion. (Marston Application, page 16, lines 5-15) The system and processing to form the bag with the microperforations in a

registered target area is also described in the patent application which explains in detail how the registered microperforations are registered in a target area – the cited art does not recite in any form a bag having microperforations in a registered target area being one-quarter from the top seal or how the microperforations would be registered in such a target area.

Dependent Claim 11

Dependent claim 11 recites:

The improved packaging material according to claim 7, wherein said bag is substantially enclosed with a top seal, a bottom seal, and a pair of side seals, and wherein said registered target area is within one-third distance from said top seal of said bag. (Marston Application Page 16, lines 5-15; Marston Application Fig. 2 ref #50)

Independent claim 1 claims the microperforations in a finite region termed a registered target area. The dependent claim 11 specifically claims the location of the finite region on the bag being located within one-third distance from the top seal. There is no reference in any of the cited art to a location for the target area let alone being one-third from the top seal.

As stated, the region is shown in Marston Fig. 2 and the positioning for the target region on the bag is placed to avoid occlusion. (Marston Application, page 16, lines 5-15) The system and processing to place the microperforations on the bag in a registered target region is described in the patent application– the cited art does not recite in any form a bag with microperforations in a registered target area being within one-third distance from the top seal or how such microperforations would be registered in a target area.

Dependent Claim 14

Dependent claim 14 recites:

The improved packaging material according to claim 1, wherein said polymeric material has a CO_2 transmission rate that is 2.5 to 5.0 times greater than the O_2 transmission rate. (Marston Application, page 9, lines 23 - 26)

The present invention teaches a packaging material that establishes the relationship between the properties of the produce and the microperforated packaging in order to calculate and establish the proper packaging atmosphere. None of the cited references establish such a relationship nor do they describe a CO_2 transmission rate in relation to the film OTR being 2.5 – 5 times greater than the film OTR. (Marston Application, page 9, lines 23 - 26)

Dependent Claim 21

Dependent claim 21 recites:

The improved packaging material according to claim 1, wherein each of said microperforations has an average diameter in the range between 120-160 microns. (Marston Application, page 19, lines 29-31; Fig. 2 ref #100)

The microperforations of the packaging of the present invention are noted as being much smaller than the microperforations used in most other microperforated packaging. While various size holes are referenced in vague terms in the references, none of the references cite such a narrow range of microperforations being 120-160 microns. (Marston Application, page 19, lines 29-31)

Dependent Claim 22

Dependent claim 22 recites:

The improved packaging material according to claim 1, wherein said polymeric material has a CO_2 transmission rate that is 3.4 to 4.0 times greater than the O_2 transmission rate. (Marston Application, page 9, lines 23 - 26)

The present invention is a packaging material that establishes the relationship between the properties of the produce and the packaging in order to establish the proper packaging atmosphere. None of the cited references establish such a relationship nor do they describe a CO_2 transmission rate in relation to the film OTR being 3.4 – 4 times greater than the film OTR. (Marston Application, page 9, lines 23 - 26)

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL (37 C.F.R. 41.37(c))

Claims 1-4, 6, 8-9, 12, 14 and 21-22 stand rejected under 35 U.S.C §103(a) as being unpatentable over U.S. Pat. No. 4,886,372 (Greengrass) in view of U.S. Pat. No. 5,919,547 (Kocher). Claims 7 and 10-11 stand rejected under 35 U.S.C §103(a) as being unpatentable over Greengrass in view of Kocher and further in view of U.S. Pat. No. 5,492,705 (Porchia). Grouping of claims is no longer required and claims are argued separately herein.

Applicant herein submits that the Examiner has applied an improper combination; the Examiner has failed to properly consider the declaration filed 8/6/2004; and the Examiner has not properly considered secondary meaning as provided in the office action responses and declaration filed 10/18/2002.

The Applicant submits that the packaging film of the present invention as recited in Claim 1 is novel and unobvious, being a set of drill hole microperforations, wherein based on a number and a size of the microperforations, control and maintain an optimum atmospheric conditions within specified O_2 and CO_2 concentrations, wherein the optimum atmospheric conditions contains less than about 20.9% O_2 and greater than about 0.03% CO_2. Furthermore there is a total O_2 Flux ranging from 150 cc/day-atm to 5,000,000 cc/day-atm and wherein each of the microperforations has an average diameter between 110 and 400 microns and the set of microperforations are placed in a registered target area on the polymeric material, with the registered target area being a finite region on the polymeric material.

ARGUMENTS (37 C.F.R. 41.37(c))

IMPROPER COMBINATION OF REFERENCES

As a preliminary matter, the Applicant submits that the combination of Greengrass with Kocher is improper in that, when taken as a whole, there is no motivation or suggestion to combine these three references to achieve the Applicant's claimed invention. Section 2143.01 of the MPEP states: "The mere fact that references can be combined or modified is not sufficient to establish prima facie obviousness." In addition, the "level of skill in the art cannot be relied

upon to provide the suggestion to combine references." Thus, it is inappropriate to use the Applicant's claims as a road map in selecting a combination of references to form a 35 U.S.C. §103(a) rejection. Rather, there must be some objective reason to combine the teachings of the references to make the claimed invention. The Applicant cannot find such an objective reason, and the Examiner has provided no such reason. The Applicant submits that there is no objective reason, and that Greengrass expressly discourages a combination with Kocher.

In more detail, Greengrass describes a mechanical perforating system that makes perforations in PVC films for produce packaging. In a typical application, rods with pins embedded into the surface of the cylinder are used to punch holes in the film with perforation rows in the film, the distance apart of the rows, the pitch of the pins used to make the holes, and the size of the holes are adjusted to meet the specific requirements of the produce. The size/shape/number of the microperforations in Greengrass employ holes intended to improve package longevity with empirical estimations related to delayed "ripening" – too many holes results in dehydration while too few holes results in excess condensation. (Greengrass Col. 2, lines 39-55) The Greengrass hole sizes are described in the various embodiments and claimed as being 20 mm to 60 mm. While Greengrass cites that the microperforations could be as small as 0.25mm (Greengrass Col. 2, lines 4-8), it does not employ this smaller hole size for any of the described embodiment (Greengrass Col. 3, lines 1-14; Col. 3, lines 24-28; Col. 3, lines 29-41; Col. 3, lines 51-57; Col. 4, lines 14-18; Col. 4, lines 30-47) and claims large hole sizes being 20 mm to 60 mm (Greengrass Claim 3). As shown in <u>all</u> the Greengrass Figures, the Greengrass perforations are not in a target area on the package, but distributed throughout the main body of the plastic film. Greengrass perforations are in rows that extend along the entire length or width of the packaging film. Thus, Greengrass uses a mechanical punch to make very large size holes to establish some atmospheric condition within the package and does not place the microperforations in a registered, finite target area.

Kocher (U.S. Pat. No. 5,919,547) is a laminate structure as depicted in Kocher Fig. 2, having layers of gas-permeable and gas-impermeable layers, bound together by adhesive, wherein the laminate, when subjected to delamination (see Kocher Fig. 3-7), provides a rapid

ingress of air into the interior of the package. "In a preferred embodiment of the invention, the laminate provides the lid for a package and delaminates into a substantially gas-impermeable portion and a gas-permeable portion, with the gas-permeable portion being bonded directly to the support member of the package. In this manner, the gas-impermeable portion may be peelably removed from the package to allow atmospheric oxygen to enter the interior of the package. In a particularly preferred embodiment, the gas-permeable portion is provided by perforating the delaminatable, coextruded film and bonding such film to the support member so that, when the laminate is caused to be delaminated within the perforated, coextruded film, the perforations are exposed to the ambient atmosphere and thereby allow for rapid ingress of oxygen into the interior of the package." (Kocher col. 4 lines 10-24) Kocher is intended to be a sealed barrier (gas-impermeable) package until a delamination occurs that separates the gas-impermeable layer from the gas-permeable layer to allow air to rapidly ingress into the container via the gas-permeable layer and the perforations so that the interior of the container has the same atmosphere as ambient air. While Kocher does discuss the use of 'perforations' used in conjunction with the multi-laminate layers – the usage pertains to removing the outer, gas-impermeable layer (lid) to allow air to flow through these perforations and gas permeable layers in a rapid manner. The perforations of Kocher are shown in Figure 6 and described in Column 17. The perforations 66 extend thru multiple layers so that when the lid is delaminated and removed (See Figure 7) the air can flow into the package via the perforations as well as the gas-permeable layer. This provides a 'swift ingress of atmospheric oxygen' (col. 17, lines 57). The described embodiments are intended for meat packages that are delaminated in the retail stores to cause the meat to develop a desirable red coloring from the oxygen introduced through the microperforations.

These packaging products are in different industries, are functionally different, and are structurally different. The laminate film of Kocher (see Kocher Fig. 6) does not remotely resemble the microperforated packaging of Greengrass (see Greengrass Fig. 1, Fig. 2, Fig. 3, Fig. 4a, Fig. 4b) and the manufacturing processes and usage of these two films are entirely different. The perforations of Kocher are shown in a delaminated presentation in Kocher Fig. 7, however this figure is derived from Kocher Fig. 6 – showing the laminate assembly that is entirely different than Greengrass. The Examiner is not allowed to pick and choose specific portions and

figures from among different unrelated patents and improperly make combinations in order to find obviousness. The Kocher and Porchia references must be considered individually and there must be some teaching, suggestion, or motivation in the references themselves or in the knowledge generally available to one of ordinary skill in the art to combine the references. The Examiner has not provided any reasonable explanation, and the level of skill in the art cannot be relied upon to provide the suggestion to combine the references. See *Al-Site Corp. v. VSI Int'l Inc.*, 174 F.3d 1308, 50 USPQ2d 1161 (Fed. Cir. 1999)

Incorporating the multi-layered laminate of Kocher with Greengrass does not produce a film suitable for either industry. A sealed impermeable laminate applied to respiring produce of Greengrass would result in spoiled produce. Likewise, having perforated films for the meat products of Kocher would result in spoiled meat as the meat would be subject to the oxidative effects of air and the growth of aerobic spoilage microorganisms throughout the shipping process. Thus, there is no logical objective basis to combine these references and none has been stated. In addition, such a combination violates § 2143.01 of the MPEP, which states that if "the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959)"

Thus, the Applicant submits that this combination of Kocher and Greengrass is improper and respectfully requests the rejection to be withdrawn.

<u>Rejection under 35 U.S.C. 103(a) over U.S. Pat. No. 4,886,372 (Greengrass) in view of U.S. Pat. No. 5,919,547 (Kocher)</u>

It is well-established that it is impermissible to use the claimed invention as an instruction manual or "template" to piece together isolated disclosures and teachings of the prior art so that the claimed invention is rendered obvious. See *In re Fritch*, 972 F.2d 1260, 1266 n.15, 23 USPQ2d 1780, 1783-84 n.15 (Fed. Cir. 1992) The Federal Circuit has also cautioned against focusing on the obviousness of the differences between the claimed invention and the prior art rather than on the obviousness of the claimed invention as a whole as 35 U.S.C §103 requires.

See *generally Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1383, 231 USPQ 81, 93 (Fed. Cir. 1986), *cert. denied*, 480 USPQ 947 (1987).

Furthermore, the Examiner bears the initial burden of establishing a prima facie case of obviousness. See *In re Oetiker*, 877 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992) To meet this burden and show that the art suggests the claimed invention, the Examiner must establish some objective teaching in the prior art or knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1998).

Applicant notes that "[i]n reviewing the [E]xaminer's decision on appeal, the Board must necessarily weigh all of the evidence and argument." See *Oetiker*, 977 F.2d at 1445, 24 USPQ2d at 1444. "[T]he Board must not only assure that the requisite findings are made, based on evidence of record, but must also explain the reasoning by which the findings are deemed to support the agency's conclusion." See *In re Lee* 277 F.3d 1338, 1344, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002)

Claim 1

In the Advisory Action dated 8/27/2004, the Examiner states that Greengrass discloses improved packaging for establishing optimum atmospheric conditions for respiring produce and references the background section of Greengrass Col 1, lines 21-32. The Examiner also states that Greengrass comprises a set of microperforations which are drill holes on a finite target area of the polymeric material. (Greengrass Col 2, lines 56-62)

The Examiner also argues that Greengrass discloses a packaging such that the microperforations control the atmospheric conditions within specified oxygen and carbon dioxide concentrations (less than 20.9% oxygen and greater than 0.03% carbon dioxide). (Greengrass Col 1, lines 33-38)

The Examiner acknowledges that Greengrass does not teach microperforations having an average diameter between 110 – 400 microns or an O_2 flux ranging from 200cc/day –atm – 1,500,000 cc/day-atm. The Examiner attempts to locate such features in the Kocher packaging patent involving multi-layered laminates. With respect to the size of the microperforations, the Examiner locates a reference within Kocher to an average diameter of 125 microns (Kocher Col 17, lines 66-67)

The Examiner further notes that Kocher fails to disclose an O_2 flux ranging from 200 cc/day-atm – 1,500,000 cc/day-atm. However, the Examiner takes official notice that Kocher discloses having O_2 flux and CO_2 transmission and that one of ordinary skill in the art would vary the microperforation size to a desired O_2 flux and CO_2 flux by routine optimization.

Applicant respectfully disagrees and strongly believes that the Examiner has failed to satisfy the burden of showing that Greeengrass alone or in combination with Kocher suggests the claimed invention. The Examiner bases his bold conclusions on vague statements that do not teach or suggest the claimed elements, relies on speculation and conjecture to support obviousness, and takes official notice as needed to support those conclusions. Applicant has expended considerable effort, as demonstrated by the responses, declarations, supporting materials and interviews to explain the present invention, the cited references and the distinguishing attributes. Quite frankly, if this is the best art the Examiner can find relative to the present invention, independent claim 1 includes features not disclosed or obvious by these references and should be allowed.

The Examiner states that Greengrass discloses improved packaging for establishing optimum atmospheric conditions for respiring produce and references the background section of Greengrass Col 1, lines 21-32. This section cited by the Examiner reads as follows:

> In relation to the provision of a container or bag in accordance with the present invention one must firstly consider the various problems associated in the packaging of produce. Firstly, live produce such as fruit and vegetables, unlike dead material such as meats, have respiration in that

> they absorb oxygen and give off carbon dioxide. When covered with a film, the atmosphere within the packing or wrapping changes. Most thin films are permeable, but even thin gauge stretch polyvinylchloride is not sufficiently so to cope with most live products. The change that takes place within the packs is called modified atmosphere (MA). (Greengrass Col 1, lines 21-32)

The Examiner thus relies upon this section as disclosing "an improved packaging for establishing optimum atmospheric conditions for respiring produce." (Office Action dated 8/27/2004, page 2, item #3) As per background on CAP and MAP and various attempts for packaging, the Applicant directs the Board to the background section of the present application which provides a much better presentation and explanation of these materials. (Marston Application, Page 1 line 27 – Page 7 line 10) The section cited by the Examiner sets for the broad intent – however Greengrass does not accomplish such an optimum atmospheric condition.

The Examiner also states that Greengrass comprises a set of microperforations which are drill holes on a finite target area of the polymeric material. In support of attributing a registered target area to Greengrass, the Examiner points to the following:

> It is preferable with the small number of openings necessary in the majority of retail packs, that they should be placed in such positions in said packs as to eliminate the possibility of product within the packs blocking the micro perforations or openings, thus reducing or totally destroying the performance of said packs. (Greengrass Col 2, lines 56-62)

Once again, Greengrass sets forth worthy goals and imputes them into the Greengrass reference - but Greengrass does not describe such a package with registered microperforations in a small identifiable target area nor does it provide any explanation as to how such microperforations would be placed in the packaging film of Greengrass.

The Examiner also argues that Greengrass discloses a packaging such that the microperforations control the atmospheric conditions within specified oxygen and carbon dioxide concentrations (less than 20.9% oxygen and greater than 0.03% carbon dioxide). Once again, in support of this conclusion, the Examiner relies upon the background section of Greengrass:

> When the levels of carbon dioxide within the pack has reached over five percent and the oxygen in the pack has been lowered to eight percent, the internal atmosphere within the pack has modified to an extent where the process of ripening of the produce or fruits has been significantly slowed. (Greengrass Col 1, lines 33-38)

As previously explained, this is an inaccurate statement concerning the concept of 'ripening' of produce. In addition, the levels achieved by Greengrass were tested by the present inventor and shown to be unachievable of the intended performance. (After Final Response dated 8/6/2004 – 7 pages of Declaration)

There is no objective teaching or suggestion in Greengrass that supports finding of the elements of the packaging material of claim 1 with respect to the microperforations establishing optimum atmospheric conditions as set forth in the present claim 1:

> a set of microperforations on said polymeric material, wherein said set of microperforations are drill holes and based on a number and a size of said microperforations, control and maintain said optimum atmospheric conditions within specified O_2 and CO_2 concentrations for said respiring produce, said optimum atmospheric conditions containing less than about 20.9% O_2 and greater than about 0.03% CO_2, wherein said polymeric material provides a total O_2 Flux ranging from 150 cc/day-atm to 5,000,000 cc/day-atm. (Marston Application – Claim 1)

The claims of the present invention define a range for the O_2 Flux, wherein the size/number of microperforations establish the total cross sectional area of the openings needed to control the optimum atmosphere inside the package. Assuming a typical packaging size, the cross sectional area of the openings in Greengrass is several orders of magnitude greater than that of the present invention. Thus, as explained in greater detail in the Declaration, Greengrass is **not** capable of the oxygen flow rates as described and claimed in the present invention, and can not provide a total O_2 Flux ranging from 150 cc/day-atm to 5,000,000 cc/day-atm as recited in Claim 1. Therefore, the rejection of Claim 1 is traversed for at least these reasons.

As noted, the Examiner references the background section of Greengrass Col. 1 lines 33-38 which states "[w]hen the levels of carbon dioxide within the pack has reached over five percent and the oxygen in the pack has been lowered to eight percent, the internal atmosphere within the pack has modified to an extent where the process of ripening of the produce or fruits has been significantly slowed." Thus, Greengrass sets forth the proposition that the CO_2 levels should be greater than 5% and O_2 less than 8% in the background section, with little support or explanation as to accomplishing this goal. Greengrass might as well as opined on any number of worthy goals in the background – but Greengrass does not describe the flux rate or atmosphere specified in Claim 1; does not establish sufficient teachings to accomplish any such rate; and based on the Marston testing in the Declaration filed 8/6/2004, Greengrass does not achieve the desired atmospheric conditions.

As is well known, ambient air contains approximately 0.20948 (21%) O_2 and about 0.0355 (.03%) CO_2. The optimal atmospheric conditions for a wide range of fresh produce items is known to those in the art and published in texts in the field. The optimum atmospheric conditions according to the present invention are calculated such that there are concentrations in the approximate range of <20% O_2 and >1% CO_2 at refrigerated temperatures. Thus the present invention seeks to maintain a stable atmosphere for the respiring produce that is different than ambient air and within the range of <20.9% O_2 and >0.03% CO_2.

And – the present invention actually teaches a produce packaging that obtains such a packaging environment and details for the resulting microperforated packaging that accomplishes that atmospheric condition along with the cited features of Claim 1. Greengrass does not explain in any sufficient form how the size/number of perforations in the packaging material relates to the control or maintenance of optimal atmospheric conditions. Only the present invention describes a packaging material that is capable of establishing such an atmospheric state.

The present invention describes in a fully enabling manner, the produce packaging and the enabling details for accomplishing the optimal atmospheric condition. The respiration rate of the fresh produce depends on a number of factors, and the present invention matches the respiration rate to the oxygen transmission rate of the film provided by the size and number of microperforations in the film to establish an optimum equilibrium (stable) atmosphere inside the package that is conducive to reduced respiration rates and shelf life extension. There is no teaching in Greengrass of the flow rate or the relationship of the atmosphere to the number/size of holes – mere speculation that some experimentation might conjure a package atmosphere does not enable such an invention nor does it define the packaging material of the present invention.

Greengrass fails to disclose any flow rate, any relationship to number and size of holes nor any description as to how one would contemplate establishing an optimal atmosphere in the package. Instead – Greengrass states that the number and size can be calculated by "scientific testing." (Greengrass Col 2, lines 1-3) And further provides no description of the testing procedure as to accomplish such testing.

Finally – the examples provided by and claimed by Greengrass clearly teach away from the present invention and demonstrates that Greengrass does not provide the atmospheric conditions of the present invention. (Greengrass Col 3, lines 7-68; Col 4, lines 6-18) All the illustrated examples of Greengrass refer to the 20mm to 60mm hole sizes. The cited hole sizes such as those in Greengrass claim 3 are so large that they are not capable of satisfying the atmospheric conditions claimed in the present invention. The teaching of Greengrass may provide some atmosphere – but it is certainly not the atmosphere described and claimed in the

present invention. The Applicant submits that Greengrass is distinguished by the elements and the rejection is traversed for at least these reasons.

Greengrass is referenced in the background section of the Marston Application beginning on page 5 line 7:

> UK Patent Application No. 2 200 618 A and European Patent Application No. 88301303.9 describe the use of a mechanical perforating method to make perforations with diameters of 0.25 mm to 60 mm in PVC films for produce packaging. Rods with pins embedded into the surface of the cylinder are used to punch holes in the film. For each produce item to be packaged, the rod/pin configuration is manually changed so that the number of perforation rows in the film, the distance apart of the rows, the pitch of the pins used to make the holes, and the size of the holes are adjusted to meet the specific requirements of the produce. The produce requirements are determined by laboratory testing produce packed in a variety of perforated films. The invention does not disclose any mathematical method to determine the appropriate size or number of perforations to use with different produce items. In addition, the hole sizes, 20 mm to 60 mm, which are claimed, would be too large to effectively control the atmosphere inside packages containing less than several kilograms of produce. Furthermore, the complicated perforation method would cause lost package production time due to equipment (perforation cylinder) change-overs for different perforation patterns. In addition, the invention cautions that the produce should be placed in the package so that the perforations are not occluded and care should be taken to prevent taping over the perforations in the film. Since the perforations are not registered in a small area on the package, but are placed throughout the main body of the plastic film, the likelihood is high that perforations will be occluded by the produce inside the package or by pressure sensitive adhesive labels applied on packages for marketing purposes. When holes are blocked, the principal route for gas transmission through the film is blocked which leads to anaerobic conditions and fermentative reactions. The result is poor sensory properties, reduced shelf

life and possible microbiological safety concerns. Therefore, it is important that perforations be registered in a well-defined area of the package where the likelihood of their occlusion during pack-out, storage, transportation, and retail display is minimized.

Thus, the Applicant was aware of the Greengrass invention, distinguished Greengrass in the background section, and cited the patent in the Information Disclosure Statement which was acknowledged by the Examiner in the Office Action dated 7/18/2002. It was only cited against the Applicant in the Office Action dated 6/4/2004. A further explanation of Greengrass was provided and supported by the Inventor Declaration submitted 8/6/2004 as well as during the personal interview held 7/29/2004.

The perforations of Greengrass are not in a 'registered target area' as the term applies to the present invention. Applicant has also further described the registered target area as being a 'finite region' on the polymeric material. The term 'finite' is defined as being limited or confined – and in the context of the microperforations – it refers to the microperforations being in a small region as opposed to being distributed throughout the packaging noted in the prior references. (Marston Application page 16, lines 5-15; page 19, lines 29-31) And, the present application details the entire system that can accomplish the placement of such microperforations in a registered target area.

The invention described in Greengrass is for a linear run employing an arrangement according to: the number of lines; the distance of lines apart (mm); the pitch of pins (mm); and the size of hole (mm). (Col 3, lines 7-10; Col 4 lines 30-34). As is readily apparent, the Greengrass punch system is not designed to register a target area on the packaging material and then place the microperforations in the registered target area. While Greengrass may express an intention to avoid blockage of the holes – the description and drawings illustrate linearly arranged holes throughout the packaging film - As noted in Greengrass Fig 1, Fig 2, Fig 1B, Fig 3, Fig 4a, Fig 4B, and the film deployed in Fig 5. The perforations are in a line across the material and not registered in a finite region of the target area and therefore not placed to avoid occlusion in a finite region as claimed by

the present application. While the Examiner may wish to impart or otherwise imagine a registration scheme to place microperforations in a finite registered target area that is not uniformly distributed throughout the packaging – there is no support or discussion in Greengrass to support these conjectures.

As already recited in the 10/18/2002 Office Action Response – "[a]s described in the present application, the registered target area is a well-defined location for the microperforations as opposed to the non-localized distribution of microperforations throughout the packaging material length and width, a condition which would make the microperforations subject to occlusion. If the microperforations are not localized in a specific area, they may be blocked by labels or occluded by package-to-package contact in case carton packing. Therefore, to ensure obstruction-free microperforations and controlled oxygen transmission rates, the placement of microperforations is accomplished as described in the present application. As noted in the specification beginning on Page 9, line 16, "[i]n the preferred embodiment, the optimal size, shape and number of the set of microperforations for the particular product is used for the registered target area. In most cases, the target area is a small identifiable area in an upper third or quarter of the package. More preferably, the registered microperforations are placed in a finite area that will not be occluded by produce or other packages during shipping and storage." And, the figures of the present application illustrate the placement of the microperforations in a finite target area. Greengrass does not support the finding of a registered target area being a finite region and the rejection of claim 1 is therefore traversed for at least these reasons.

In addition, the holes of Greengrass are mechanical punch holes ranging from 20mm to 60mm as described in Greengrass Col 5 lines 30-40 and claimed in Greengrass claim 3. The present invention has demonstrated that the drill hole preferably range in the neighborhood of 110-400 microns. There are 1000 microns to one mm, so the Greengrass punch holes are in the range of 20,000 microns to 60,000 microns. Thus the Greengrass invention is clearly intended to employ perforations of a much greater magnitude than the present invention.

To support the Examiner's conclusion, Greengrass states that "[i]t is possible that, for

retail packs containing as little as 500 grams of produce, a single micro perforation opening as small as 0.25 mm in diameter per pack may be all that is required to delay ripening." Thus, a punched perforation of 250 microns was cited in Greengrass – but the Greengrass invention clearly teaches away from using such smaller holes throughout the rest of the Greengrass patent.

The examples described in Greengrass all support larger size holes, "wherein the arrangement number of lines/distance lines apart (mm)/pitch of pins (mm)/size of holes (mm) utilized is selected from the group consisting of: 11/25/50/60, 05/20/30/60, 01/00/50/20, and 03/25/50/20." (Greengrass claim 3) These punch holes of 20,000 to 60,000 microns are **not** sufficient, e.g., they are too large, for the control of the atmospheric conditions according to the present invention that employs laser drill holes in the range of about 110 – 400 microns. This is already stated herein and also set forth in the background section of the present application and further articulated in the Declaration submitted 8/6/2004.

The Figures of Greengrass – Fig. 1, Fig. 2, Fig. 1B, Fig. 3, Fig. 4A, Fig. 4B, Fig. 5 – all show holes that are visible in the displayed packaging thus supporting that these holes are very large. As clearly described in Greengrass, the arrangement of the punch holes according to the number of lines/distance of lines apart (mm)/pitch of pins (mm)/size of hole (mm) – the holes are uniformly distributed throughout the packaging and include a number of very large size holes (20,000 to 60,000 microns). The examples disclosed patterns using microperforations with arrangements: 11/25/50/60; 05/20/30/60; 01/00/50/20; and 03/25/50/20. These large hole sizes would permit not only the flow of gas, but water and debris as well.

In the Advisory Action dated 8/27/2004, the Examiner acknowledges that Greengrass does not teach microperforations having an average diameter between 110 – 400 microns or an O_2 flux ranging from 200cc/day –atm – 1,500,000 cc/day-atm. (Advisory Action 8/27/2004, page 3) The Examiner attempts to locate such features in the Kocher packaging patent involving multi-layered laminates. The Examiner fails to satisfy the initial burden of showing an objective teaching or suggestion of the combination of Greengrass and Kocher, however even if such a objective basis is possible, the laminate of Kocher also fails to establish any parameters or

teachings for a flux rate or atmospheric condition as recited in Marston Claim 1.

As already established in the record, Kocher employs laminates or layers of gas-permeable and gas-impermeable layers. Using the terminology of Kocher – "In a preferred embodiment of the invention, the laminate provides the lid for a package and delaminates into a substantially gas-impermeable portion and a gas-permeable portion, with the gas-permeable portion being bonded directly to the support member of the package. In this manner, the gas-impermeable portion may be peelably removed from the package to allow atmospheric oxygen to enter the interior of the package. In a particularly preferred embodiment, the gas-permeable portion is provided by perforating the delaminatable, coextruded film and bonding such film to the support member so that, when the laminate is caused to be delaminated within the perforated, coextruded film, the perforations are exposed to the ambient atmosphere and thereby allow for rapid ingress of oxygen into the interior of the package." (Kocher col. 4 lines 10-24)

Kocher is specifically intended to be a sealed, gas-impermeable package until a de-lamination occurs and then have air ingress via the gas-permeable layer and the perforations. This multi-layer approach of Kocher is distinguishable from the present invention. While Kocher does discuss the use of perforations used in conjunction with the multi-laminate layers Kocher does not disclose a polymeric material having drill holes in a registered target area in a manner as to control the atmospheric conditions as stipulated in Marston Claim 1.

The Kocher usage pertains to removing the outer gas-impermeable layer (lid) to allow air to flow through these perforations and gas permeable layers. The perforations of Kocher are shown in Kocher Figure 6 and described in Kocher Column 17. The Kocher perforations 66 extend through multiple layers so that when the gas-impermeable lid is delaminated and removed (See Kocher Figure 7) the air can flow into the package via the perforations as well as the gas-permeable layer. This provides a 'swift ingress of atmospheric oxygen' as the object of Kocher is to employ holes to quickly establish an ambient air atmosphere. (Kocher col. 17, line 57)

The reference by the Examiner (Advisory Action page 3) that Kocher perforations are intended for longer shelf life is from Background section of Kocher. (Col 1 lines 30-31) Taken in proper context, the Kocher paragraph refers to the central processing and packaging of meats instead of cutting the meat in each supermarket. This central processing would provide convenience to the store managers, where labor shortages are common, and provide a longer shelf-life - with no reference to microperforations. "Historically, large sub-primal cuts of meat have been butchered and packaged in each supermarket. This arrangement has long been recognized to be inefficient and expensive. It would instead be preferable to butcher and package the meat at a central processing facility which benefits from economies of scale, and then ship the packaged meat to benefits from economies of scale, and then ship the packaged meat to individual supermarkets or other retail outlets such as is done, for example, with many poultry products. <u>It is believed that central processing of meat would also lead to a higher quality, more sanitary product with a longer shelf-life than meat which is butchered and packaged in individual supermarkets</u>." (Kocher Col 1, lines 19-31)

Thus the Applicant contends that Kocher does not support the allegation by the Examiner that the Kocher microperforated packaging is intended for longer shelf life. The Kocher perforations are only intended for meat displays such that when the sealing film is removed the perforations quickly allow air to enter and turn the meat red. It is the sealed packaging of Kocher and central processing of the meats – with no air flow – that allows a longer meat shelf life in Kocher.

The Examiner acknowledges that Kocher fails to disclose a packaging material with an oxygen flux ranging from 200 cc/day – atm to 1,500,000 cc/day – atm. (Advisory Action 8/27/2004, page 3) The Examiner then references Kocher as disclosing "a packaging material providing an oxygen flux (oxygen passes through the material; column 18, lines 66-67; column 18, lines 1-5), and a carbon dioxide transmission rate (carbon dioxide passes through the material; column 17, lines 66-67; column 18, lines 1-5), and teaches the selection of microperforation size depending on the desired passage of atmospheric gas, including oxygen and carbon dioxide (column 18, lines 1-3)." (Advisory Action dated 8/27/2004, page 3 and 4)

Applicant respectfully requests that the Board review this cited Kocher section and use their sound judgment as to whether this section supports the Examiner's conclusions.

The cited Kocher section states:

> Perforations 66 preferably range from about 5 to about 250 microns in diameter, more preferably 25 to 125 microns, and most preferably 75 to 100 microns in diameter. Ideally, the perforations are large enough to permit the passage of atmospheric gas therethrough (oxygen, nitrogen, carbon dioxide), but small enough to prevent the passage of liquids or dirt. (Kocher Col 17, lines 66-67; Col 18, lines 1-5).

Applicant is bewildered as to how this section teaches the flux and atmospheric conditions of Marston Claim 1. The Examiner tries to assert an official notice that establishing an oxygen flux and carbon dioxide flux would be readily determined through 'routine optimization' (Advisory Action dated 8/27/2004, page 4).

The Applicant disagrees with the Examiner's official notice in its entirety as it is based on a faulty premise, namely that Kocher suggests or describes controlling an atmospheric condition in the package and having a flux rate thereof to satisfy an end result of an optimum atmospheric condition different than ambient air. The Board is kindly reminded that "assertions of technical fact in areas of esoteric technology must always be supported by citation of some reference work" and "allegations concerning specific knowledge of the prior art, which might be peculiar to a particular art should also be supported." MPEP § 2144.03. The Applicant notes that a reference that merely discloses or suggests the general concept of perforation in a package is not sufficient to establish a prima facie case of obviousness for a flux rate. Rather, the reference or references must disclose or suggest a flux rate along with the other features as defined by the Marston Claim 1. If it were obvious, then it should be easy to find a reference that suggests modifying the cited references to include a flux rate as recited in Marston Claim 1.

And, there would need to be sufficient description of the desired end result that would provide an optimal atmosphere for the packaged produce. There are no references that provide

the desired end result for which the user would be using such routine optimization and no references that describe the oxygen flux/carbon dioxide transmission rates.

Kocher describes microperforation size, which is in the range of 5-250 microns, however there is nothing to indicate how or why Kocher would try to control the package atmosphere or any reference to Kocher providing an oxygen flux and a carbon dioxide transmission rate. Quite simply - there is no description in Kocher of any sort for oxygen flux rate /carbon dioxide transmission rate as that is not a function of Kocher.

The overall purpose and end result of Kocher is to quickly achieve ambient air atmosphere (20.9% O_2/0.03% CO_2) to turn the meat red once the delamination occurs. (Kocher col. 18, lines 64-67; col. 19 lines 1-10) Kocher seeks to let ambient air into the container and establish an ambient atmosphere - Kocher is not seeking to establish certain optimum atmospheric conditions according to established O_2 and CO_2 concentrations different then ambient or to have a desired flux to accomplish any such atmosphere.

The reasoning of the Examiner is flawed and should be reversed as there is no cited reason in Kocher to support the purpose of establishing a flux rate to control the atmospheric condition in the package that is different than ambient air. There is absolutely no reference in Kocher to establish and maintain any sort of non-ambient oxygen/carbon dioxide concentrations once the sealed perforations are exposed and no basis or support to establish that Kocher controls the flow of gases – once the delamination occurs. The interim period during which the Kocher product is seeking ambient air used does not establish 'control' of the optimum atmospheric conditions using the perforations. Even if one were to employ any of the size ranges provided in Kocher, it still does not support any finding for establishing the oxygen flux rate from 150 cc/day-atm to 5,000,000 cc/day – atm.

Claims 6, 14, and 22

In addition, the rejection of claims 6, 14 and 22 is also traversed in relation to the further feature of having a carbon dioxide transmission rate that is 3.4 to 4.0 times greater than the

oxygen transmission rate or an oxygen flux rate from 200 cc/day-atm to 1,500,000 cc/day-atm. The Examiner again references the vague portion of Kocher in support of the misdirected rejection of these claims. (Advisory Action dated 8/27/2004) As already described, the ambient-seeking perforations of Kocher are used once delamination occurs to make the meat red. There is nothing in the cited references or the Kocher desired end result to support the 'routine optimization' stated by the Examiner and these rejections cannot be maintained.

It should be noted that the Examiner previously withdrew this rejection based upon the Response filed 2/24/04. Applicant refers the Board to the detailed explanation and arguments of that prior Response as the Applicant believes that this rejection was already traversed and allowability noted. More specifically, on page 2 of the Office Action dated 6/4/2004, the "35 U.S.C. 103(a) rejection of claims 5-6, 14 and 22 as being unpatentable over Kocher et al (U.S. Patent No. 5,919,547), of record on page 3 of the previous Action, is withdrawn." It is unclear how the Examiner now resurrects these withdrawn rejections alone or in combination with Greengrass.

Rejection under 35 U.S.C. 103(a) over U.S. Pat. No. 4,886,372 (Greengrass) in view of U.S. Pat. No. 5,919,547 (Kocher) and further in view of Porchia (U.S. Patent No. 5,492,705)

The Examiner also rejected claim 7 and 10-11 under 35 U.S.C. 103(a) as being unpatentable over Greengrass in view of Kocher (US Patent 5,919,547) and further in view of Porchia (U.S. Patent No. 5,492,705). The Examiner acknowledged that Kocher does not disclose a microperforated bag or a registered target within one-quarter or one-third distance from the top seal. (Advisory Action dated 8/27/2004)

But, the Examiner states the Porchia teaches use of a microperforated bag for controlling weight loss with the microperforations in the top quarter or top third of the bag. As Porchia has holes throughout the bag, the Applicant fails to see this as being similar, as the present claims recite the microperforations being in a finite region – not distributed throughout. Apparently, the Examiner asserts that because the Porchia microholes are distributed throughout, they are within any distance from the top seal, although this completely disregards the claimed limitation of

being in a finite region.

Porchia clearly establishes the microhole distribution in the Porchia packaging. “By "uniformly distributed" it is meant that the microholes are substantially identically and substantially evenly spaced apart from each other over the entire surface area of the web film or bag." (Porchia, Col. 4, lines 37-40) "To obtain the beneficial effects of the present invention, the microholes should be of a uniform size and uniformly distributed throughout the surface of the bag." (Porchia, Col. 4, lines 34-36). Porchia Figure 1 also shows the microperforations over the entire bag, and not exclusively in a registered finite target area as described and claimed in the present invention.

More importantly, the Examiner correctly recites that Porchia has a desired end result of controlling the weight loss of fruit. (Advisory Action page 6 and 12) But, fails to explain or establish the relationship or importance with respect to the present invention. As already described, the present invention provides for an optimum atmospheric condition that controls and maintains an optimal packaging atmospheric. Porchia does not control the package atmosphere, and while produce weight loss is a by-product of the controlled atmospheric state – it is a different function than Porchia. Controlling weight loss for fresh produce involves establishing a water vapor transmission rate so that there is not too much moisture in the bag to cause slime formation of the tissue, and at the same time, not allowing too much moisture to escape and result in wilting/desiccation of the produce. This is not the controlled atmosphere taught by the present invention. Thus the desired end result of Porchia is NOT the same as the present invention. Commencing with this faulty premise, the Examiner combines the three references and finds obviousness.

Porchia describes a packaging bag with microholes throughout that is “independent of product, shape, amount and transpiration characteristics of stored produce as opposed to controlled atmosphere which generally is designed for each specific packaged product." (Porchia Col. 2, Lines 19-22) Thus, Porchia acknowledges that it is not intended for controlling atmospheric conditions.

Therefore, Porchia does not control and maintain the oxygen and carbon dioxide concentration inside the bag and does not register the microperforations in a finite target area as claimed in the present invention. Taken alone or in combination with Kocher and/or Greengrass, these references do not disclose, suggest or otherwise provide a motivation to practice the claims of the present invention. The rejection of claims 7 and 10-11 is traversed for at least the reasons presented herein.

Finally, with respect to obviousness, there is an inventor declaration along with multiple exhibits filed 10/18/2002 that provide exemplary secondary considerations that the Applicant would like to be considered before the Examiner summarily concludes that control of atmospheric conditions via microperforations is obvious. The success of the product in the marketplace is yet another indicator that such a conclusion is unfounded. The rejection of all claims are traversed for at least the reasons presented herein.

DECLARATION (37 CFR 1.132) – GREENGRASS FILED 7/29/2004

As noted in the Interview Summary dated 7/29/2004, the Examiner indicated that a Declaration would be considered to show that Greengrass could not achieve the presently claimed features. The Rule 132 Inventor Declaration submitted on 8/6/2004 contained specific test data that Greengrass was not capable of establishing the flow rate or the atmospheric conditions of the claimed present invention and furthermore that the processing which the Examiner indicates is easily derived by empirical testing – is not.

The Examiner summarily dismisses this Declaration by stating that "Greengrass et al is not limited to the perforation sizes of the examples, as microperforations are taught by Greengrass et al. The closest prior art, as stated above, is the film disclosed by Greengrass et al provided with the perforation size of Kocher et al."

Once again, the Examiner wants to use the claimed invention as an instruction manual or "template" to piece together isolated disclosures and teachings of the prior art so that the claimed invention is rendered obvious. This is improper interpretation of the statute. Applicant also

contends that the combination is improper as detailed herein.

Every field has subtleties that are appreciated and understood by those in the field, and it requires a sophistication or knowledge of that art. To those that are not in that field, these subtleties may sometimes appear trivial or unimportant – thus it is important to make well-founded assumptions based on objective criteria.

As an analogy, the under-signed Attorney recently had an experienced landscaper start a rock retaining wall. To the unskilled, the process seems simple – just put rocks on top of each other. After wasting several hours, it became readily apparent that even placing rocks requires a base knowledge and skill set that the under-signed Attorney was seriously lacking.

As already explained and described, the film of Greengrass and the laminate of Kocher are not similar. The Examiner cited Greengrass in support of a certain controlled atmosphere, which the inventor demonstrates via the Declaration submitted 8/6/2004 is not possible by employing the examples used in Greengrass. As argued herein, using the present invention as a roadmap and stringing together elements from various references to find obviousness is not a proper interpretation of 35 USC 103(a).

The Declaration dated 8/6/2004 clearly shows that the Greengrass testing results for the number of lines/distance of lines apart/pitch of pins/size of holes is not capable of satisfying the criteria of the packaging material of the present invention. This was also demonstrated to the Examiner during the Personal Interview held 7/29/2004, wherein the measurements of the headspace oxygen and carbon dioxide levels showed the performance characteristics and established that Greengrass is <u>not</u> capable of controlling and maintaining optimum atmospheric conditions within specified O_2 and CO_2 concentrations for the respiring produce. The Examiner maintains this aspect in the latest rejection despite the Declaration, the supporting test data and the live demonstration at the Patent Office - apparently relying on different hole sizes from the laminate film of Kocher that would control and maintain these features of Marston Claim 1.

As noted, Greengrass is not capable of establishing the optimum atmospheric conditions containing less than about 20.9% O_2 and greater than about 0.03% CO_2, wherein the polymeric material provides a total O_2 Flux ranging from 150 cc/day-atm to 5,000,000 cc/day-atm. Greengrass does not teach or suggest the present claimed invention as the hole sizes – recited throughout Greengrass and also illustrated in the figures – demonstrate that the large hole sizes were a feature of that invention. Even in combination with Kocher, the Examiner takes official notice – with no supporting references – to reject the skilled opinion of the Inventor and the secondary considerations to reject these features of Marston Claim 1.

The Declaration submitted 10/18/2002 was provided to attest that one skilled in the art would not readily determine the number/size of the microperforations via empirical testing and it would require at least undue experimentation. Once again, rather than rely on the inventor declaration from someone with 21 years of industry experience and in spite of the secondary considerations already of record related to commercial success – the Examiner finds states that such a determination is easy and simply requires that one "vary the microperforation size in order to obtain a desired oxygen and carbon dioxide flux, since the oxygen and carbon dioxide flux would be readily determined through routine optimization by one having ordinary skill in the art depending upon the desired end result as shown by Kocher et al." (Office Action dated 8/27/2004, page 4, paragraph 1).

The Applicant does not believe that the Declaration submitted 10/18/2002 or the Declaration submitted 8/6/2004 was given proper consideration and respectfully requests that the Board reconsider the Declarations in support of the present claims.

SECONDARY MEANING

The inventor is an expert in this field as detailed in the Inventor Declaration submitted 10/18/2002. (Marston Declaration dated 10/18/2002 pages 1 - 3) The inventor has stated in the Rule 132 Declaration the background for the invention, the features of the invention that distinguish it from the state of the art, and why these features are unique attributes. Multiple

exhibits were provided to visibly explain the different packaging materials (Exhibits A- J) and test data comparisons were provided for bananas and green onions demonstrating the unexpected results in extending the shelf life of the produce.

The inventor has a much greater knowledge of the inventive technology and in a far better position to assess obviousness. The inventor emphatically declared that the present invention is not obvious as compared to the references. And, the inventor has provided objective data to support a finding of non-obviousness.

The product is a commercial success and under several license agreements as stated in the Office Action Response filed 10/18/2002 on page 16. Misuse of the technology was cited with specificity and continues to be a problem without adequate patent protection. (Marston Declaration dated 10/18/2002 pages 5 – 6)

Third-party testimonials have been submitted that affirm the unexpected success of the packaging and test data provided that supports the exceptional quality from the present packaging. Among the supporting exhibits is a letter (LETTER 1) concerning banana packaging trials between Del Monte packaging personnel includes a note stating: "Dr. Marston, I'm somewhat surprised by overall results. I'll try to send you a short letter before I start a 1-month travel period Friday." (LETTER 1, note on bottom) A further communication (LETTER 2) includes notes for the comparison of testing of the packaging material of the present invention and Banavac packaging. "Both test bags performed better than the banavac standards, but I don't know if the differences are of significance. And I'm at a loss to understand why perforated bags should maintain a higher level of carbon dioxide under these conditions." (LETTER 2, 3rd paragraph) Further exhibits, LETTER 3 and LETTER 4 show additional trials using the packaging of the present invention and the exceptional performance achieved. Thus, even among those in this trade, the packaging of the present invention produces an unexpected result.

Pursuant to a suggestion from the Examiner, a further Declaration was filed 8/6/2004 in which the inventor specifically tested the Greengrass packaging and provided test data to

demonstrate the atmospheric conditions provided by the Greengrass packaging and detailed the differences in comparison to the present invention. (Marston Declaration dated 8/6/2004 pages 1 – 7)

Despite all the proffered declarations, test data, secondary considerations and exhibits – the Examiner still relies upon a subjective finding of obviousness with no objective support. Accordingly it is submitted that the Rule 132 Declarations provide convincing evidence of the long-felt need for the present invention and the commercial success rebuts the obvious rejection and respectfully requests allowance of the present claims.

THE REFERENCES

The following references have been relied upon by the Examiner for the final rejection upon which the appeal is based, and this list is provided for the convenience of the Board.

Porchia	U.S. Pat. No. 5,492,705
Kocher	U.S. Pat. No. 5,919,547
Greengrass	U.S. Pat. No. 4,886,372

BRIEF DESCRIPTION OF THE REFERENCES

A brief description of the references in relation to the present invention is provided to aid in distinguishing the prior references from the present invention and is provided for the convenience of the Board.

Greengrass U.S. Pat. No. 4,886,372

Greengrass (U.S. Pat. No. 4,886,372) discloses a perforation system which is also described in UK Patent Application No. 2 200 618 A and European Patent Application No. 88301303.9. The mechanical perforating system makes perforations in PVC films for produce packaging. In a typical application, rods with pins embedded into the surface of the cylinder are used to punch holes in the film. For each produce item to be packaged, the rod/pin configuration is manually changed so that the number of perforation rows in the film, the distance apart of the

rows, the pitch of the pins used to make the holes, and the size of the holes are adjusted to meet the specific requirements of the produce.

The requirements as to the size/shape/number for the microperforations in Greengrass to control the package atmosphere are described in terms of empirical estimations related to delayed "ripening" – too many holes results in dehydration while too few holes results in excess condensation. (Greengrass Col 2, lines 39-55) In contrast, the present invention describes and claims the proper size/number of microperforations so that the end product has the correct size/shape/number of microperforations in terms of the oxygen and carbon dioxide transmission rates which approximately matches fresh produce respiration rates. Greengrass does not discuss flux rate and references oxygen and carbon dioxide levels in the background section (Greengrass Col 1, lines 33-42) in a rudimentary fashion that is better described in the background of the present application (Present Application page 1 lines 26-30; pages 2, lines 1-28; page 3, lines 1-26.)

The Greengrass hole sizes are described in the various embodiments and claimed as being 20 mm to 60 mm. In contrast the microperforations of the present invention are described and claimed as being in the range from 0.11mm to 0.4 mm. While Greengrass cites that the microperforations could be as small as 0.25mm, it does not employ this hole size for any embodiments and specifically describes and claims large hole sizes.

The Greengrass patent cautions that the produce should be placed in the package so that the perforations are not occluded and that care should be taken to prevent taping over the perforations in the film. However, the Greengrass perforations are not in a registered finite target area on the package, but distributed throughout the main body of the plastic film. Greengrass perforations are in rows that extend along the entire length or width of the packaging film. Thus, Greengrass uses a mechanical punch to make very large size holes to establish some atmospheric condition within the package and does not place the microperforations in a registered, finite target area.

Applicant notes that the Greengrass reference was cited in the Applicant's Information Disclosure Statement dated 6/7/2001 via the Greengrass reference GB2200618A for which the Examiner acknowledged in the Office Action dated 7/18/2002. Furthermore, Greengrass was specifically addressed in the background section of the present specification.

Kocher U.S. Pat. No. 5,919,547

Kocher (U.S. Pat. No. 5,919,547) is a laminate structure as depicted in Kocher Fig. 2, having layers of gas-permeable and gas-impermeable layers wherein the laminate when subjected to delamination (see Kocher Fig. 3-7) provides a rapid ingress of air into the interior of the package. Kocher provides definitions in Column 4 that help explain the Kocher 'laminate' and a thorough explanation of the laminate usage. "In a preferred embodiment of the invention, the laminate provides the lid for a package and delaminates into a substantially gas-impermeable portion and a gas-permeable portion, with the gas-permeable portion being bonded directly to the support member of the package. In this manner, the gas-impermeable portion may be peelably removed from the package to allow atmospheric oxygen to enter the interior of the package. In a particularly preferred embodiment, the gas-permeable portion is provided by perforating the delaminatable, coextruded film and bonding such film to the support member so that, when the laminate is caused to be delaminated within the perforated, coextruded film, the perforations are exposed to the ambient atmosphere and thereby allow for rapid ingress of oxygen into the interior of the package." (Kocher col. 4 lines 10-24)

Kocher is intended to be a sealed barrier package until a delamination occurs and then have air ingress into the container via the gas-permeable layer and the perforations so that the interior of the container has the same atmosphere as ambient air. This multi-layer approach of Kocher is distinguishable from the present invention. While Kocher does discuss the use of 'perforations' used in conjunction with the multi-laminate layers – the usage pertains to removing the outer layer (lid) to allow air to flow through these perforations and gas permeable layers in a rapid manner. The perforations of Kocher are shown in Figure 6 and described in Column 17. The perforations 66 extend thru multiple layers so that when the lid is delaminated and removed (See Figure 7) the air can flow into the package via the perforations as well as the

gas-permeable layer. This provides a 'swift ingress of atmospheric oxygen' (col. 17, lines 57). The described embodiments are for meat packages that are delaminated in the stores to provide a red coloring from the oxygen introduced through the microperforations. There is no controlling of the air flow once the delamination occurs and no maintaining of the internal atmosphere in the container at some atmosphere other than ambient air, and there are no microperforations in a registered target area. This packaging was demonstrated by the inventor during the personal interview.

<u>Porchia   U.S. Pat. No. 5,492,705</u>

Porchia (U.S. Pat. No. 5,492,705) describes a packaging bag (see Porchia Fig. 1) with microholes throughout that is "independent of product, shape, amount and transpiration characteristics of stored produce as opposed to controlled atmosphere which generally is designed for each specific packaged product." (col. 2, Lines 19-22) Thus, Porchia admits that it is not intended for controlling atmospheric conditions for specific oxygen/carbon dioxide rates.

The Porchia packaging "controls the weight loss of produce" and "localized condensation in the bag" by controlling the water vapor transmission rate of the package. (Porchia Col 2, lines 26-29) And, the purpose of the microholes is to pass moisture, wherein "[the shape of the microholes is not critical, as long as the holes allow moisture to pass therethrough." (Porchia Col 4, lines 29-30) Controlling weight loss for fresh produce involves establishing a water vapor transmission rate so that there is not too much moisture in the bag to cause slime formation of the tissue, and at the same time, not allowing too much moisture to escape and result in wilting/desiccation of the produce. (Porchia Col 2, lines 8-12; 14-16; 30-33)

This requires a large number of large holes in the bag to get the Padres Number needed – (Porchia Fig. 4; Col 5, lines 1-37) The Porchia packaging describe having microholes where the number and size of the holes provide the required void fraction which represents a ratio of the total void area of the package to the total surface area of the package. (Porchia Col 4, lines 1-10) The examples provided in the Porchia Tables are all test results related to water weight loss. (Porchia Table I - XXVI).

The holes of Porchia are generally about 2000 microns (Porchia Col 3, lines 42-45) although many different ranges of hole sizes are discussed. (Porchia Col 3, lines 46-67) Thus, Porchia is specifically addressing water vapor transmission – not the oxygen/carbon dioxide concentrations as in the present invention.

Regarding location in a registered target area as described in the present invention, Porchia helps by defining their distribution. “By "uniformly distributed" it is meant that the microholes are substantially identically and substantially evenly spaced apart from each other over the entire surface area of the web film or bag." (Porchia col. 4, lines 37-40) "To obtain the beneficial effects of the present invention, the microholes should be of a uniform size and uniformly distributed throughout the surface of the bag." (Porchia col. 4, lines 34-36; see also Fig. 1) Therefore, Porchia does not employ size/number of microperforations to control the oxygen and carbon dioxide concentration inside the bag/package, does not register the microperforations in a well-defined target area on the bag, and does not establish any flux rate as in the present invention. This is because Porchia is intended for a completely different function.

Request:

Reversal of the Examiner’s final rejection of claims 1-4, 6-12, 14, 21 and 22 under 35 U.S.C. 103(a) is respectfully requested for at least the reasons set forth herein.

Respectfully submitted,

Scott J. Asmus

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CERTIFICATE OF MAILING 37 CFR 1.8: I certify that this correspondence is being deposited on the below date with the U.S. Postal Service with sufficient postage as FIRST CLASS MAIL addressed to: Mail Stop Appeal Brief - Patents, Board of Patent Appeals & Interferences, USPTO, PO Box 1450, Alexandra, VA 22313-1450.

Debra A. Stengel

Date: 11/04/2004 [✓] Debra A. Stengel ~~or [ ] Scott J. Asmus, Reg. No. 42,269~~

CLAIMS APPENDIX (37 CFR 41.37(c))

The claims on appeal appear as follows:

1. An improved packaging for establishing optimum atmospheric conditions for respiring produce, comprising:

   a non-porous polymeric material;

   a set of microperforations on said polymeric material, wherein said set of microperforations are drill holes and based on a number and a size of said microperforations, control and maintain said optimum atmospheric conditions within specified O_2 and CO_2 concentrations for said respiring produce, said optimum atmospheric conditions containing less than about 20.9% O_2 and greater than about 0.03% CO_2, wherein said polymeric material provides a total O_2 Flux ranging from 150 cc/day-atm to 5,000,000 cc/day-atm and wherein each of said microperforations has an average diameter between 110 and 400 microns and said set of microperforations are placed in a registered target area on said polymeric material, said registered target area being a finite region on said polymeric material.

2. The improved packaging material according to claim 1, wherein said polymeric material is selected from the group consisting of polyethylene, polypropylene, polyester, nylon, polystyrene, styrene butadiene, cellophane, and polyvinyl chloride, in monolayers, coextrusions, or laminates.

3. The improved packaging material according to claim 1, wherein said polymeric material is heat-sealable.

4. The improved packaging material according to claim 1, wherein said polymeric material has a thickness in the range of 0.4 to 8 mil.

5. (Canceled)

6. The improved packaging material according to claim 1, wherein said polymeric material provides a total O_2 Flux ranging from 200 cc/day-atm to 1,500,000 cc/day-atm.

7. The improved packaging material according to claim 1, wherein said polymeric material forms a bag.

8. The improved packaging material according to claim 1, wherein said polymeric material is a heat sealable film forming a lid.

9. The improved packaging material according to claim 1, wherein said polymeric material is formed into a semi-rigid container with a thickness greater than 25 mil.

10. The improved packaging material according to claim 7, wherein said bag is substantially enclosed with a top seal, a bottom seal, and a pair of side seals, and wherein said registered target area is within one-quarter distance from said top seal of said bag.

11. The improved packaging material according to claim 7, wherein said bag is substantially enclosed with a top seal, a bottom seal, and a pair of side seals, and wherein said registered target area is within one-third distance from said top seal of said bag.

12. The improved packaging material according to claim 1, wherein said registered target area is located in an area that prevents occlusion of the microperforations by product, labels or other packages.

13. (Canceled)

14. The improved packaging material according to claim 1, wherein said polymeric material has a CO_2 transmission rate that is 2.5 to 5.0 times greater than the O_2 transmission rate.

21. The improved packaging material according to claim 1, wherein each of said microperforations has an average diameter in the range between 120-160 microns.

22. The improved packaging material according to claim 1, wherein said polymeric material has a CO_2 transmission rate that is 3.4 to 4.0 times greater than the O_2 transmission rate.

EVIDENCE APPENDIX (37 CFR 41.37(c))

All Evidence is already part of the file history, including the inventor declarations, supporting exhibits, and samples of the packaging films and incorporated by reference. If the Board requires any materials including samples of the packaging films, please contact the undersigned Attorney. The following is provided for convenience to locate materials within certain responses.

Copies of the following materials are provided for the convenience of the Board:

From the Office Action Response filed 10/18/2002:

9 pages Rule 132 Declaration

Exhibits A-J, Letters 1-5 and 5 articles

From the Office Action Response filed 8/6/2004:

7 pages Rule 132 Declaration

4 pages UC Davis technology paper

2 pages Wiley encyclopedia

RELATED PROCEEDINGS APPENDIX (37 CFR 41.37(c))

There are no decisions rendered by a court or the Board in any proceeding identified in the related appeals and interferenes section.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: VARRIANO-MARSTON, Elizabeth   Group Art Unit: 1772

Serial No. 09/877,757   Examiner: Patterson, Marc

Filed: 06/08/2001   Atty. Dkt. No: MARS93-DIV

For: REGISTERED MICROPERFORATED FILMS FOR MODIFIED/CONTROLLED ATMOSPHERE PACKAGING

To: Mail Stop AF
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

From: 24222

Dear Honorable Commissioner:

This declaration is offered in support of the above application for patent.

RULE 132 DECLARATION OF ELIZABETH VARRIANO-MARSTON (37 CFR 1.132)

This Declaration is submitted following a Personal Interview on July 29, 2004, attended by Patent Examiner Marc Patterson, Attorney Scott Asmus and the under signed Inventor, Elizabeth Marston. My background and experience in the field has already been described in the Declaration dated Oct. 18, 2002 and is incorporated by reference herein.

During the Interview, I described the distinctions between the present invention and the Greengrass patent. As an expert in microperforation technology, Greengrass could not control the atmosphere at optimum conditions inside retail packages (weighing 10 lbs or less) of produce using the examples that they describe in their patent due to the extremely large size holes described therein. The hole size and number of holes is directly related to the O_2 flux noted in Claim 1 which is, of course, related to controlling and maintaining the atmosphere in the package. As detailed herein, it is not possible to establish the claimed flow rate nor the atmospheric conditions in the packaging as set forth in the present invention using the Greengrass hole size/number of holes.

For example, Greengrass describes on column 3, line 7, "[w]hen micro perforation pattern, utilizing the arrangement no. of lines/distance lines apart (mm)/pitch of pins (mm)/ size of holes (mm) 05/20/30/60 was used on PVC stretch film overwrapped punnets, not only was the weight loss of the mushrooms significantly reduced, the mushrooms would keep for periods of up to six days longer than spiked packs before going brown."

Using the above example from Greengrass, I have calculated the flux rates required to maintain an optimum atmosphere inside a package of whole mushrooms. Since Greengrass does not indicate what weights of produce they tested, I selected a weight of 40 oz (1.135 kg) whole mushrooms. Equations (1), (2), and (3) below (from the present application) is used to determine the total O_2 Flux ($Flux_{O2\text{-}Total}$) requirements of a fresh produce package, including the O_2 Flux of the breathable area of the packaging film ($Flux_{O2\text{-}film}$), and the O_2 Flux of the microperforations ($Flux_{O2\text{-}MP}$), required to maintain a desired atmosphere inside a package containing a specific fresh fruit, fresh vegetable, fresh herb or fresh flower.

(1) $OTR_T = [(M \times RR) \ / \ (A_S \, P \, (0.21 - IntO_2))] \times 24$ hrs/day

where,

OTR_T	=	total OTR required for the package in cc O_2 / m^2-day-atm
M	=	mass of produce (kg)
RR	=	respiration rate (cc O_2/kg/hr) @ the expected storage temperature
A_S	=	breathable surface area of the package (m^2)
P	=	atmospheric pressure (atm), assumed to be 1
Int O_2	=	desired O_2 atmosphere inside the package stated as a volume fraction (i.e., if the desired O_2 is 8%, the volume fraction is 0.08).

For the Greengass example, to establish an optimum atmosphere of 3% O_2 and 10% CO_2 at 5° C (see Postharvest Produce Fact Sheet, attached) inside a tray containing 1.135 kg of whole mushrooms and overwrapped with microperforated PVC film, with dimensions of 34.29 cm wide x 48.22 cm long x 25 micron thick ($OTR_{base\text{-}film}$ = 13,330 cc/m^2-day-atm – see Table 2 Properties

from the Wiley Encyclopedia of Packaging Technology, attached), with an O_2 respiration rate of 35 cc/kg/hr, the OTR_T required by the package would be:

$$OTR_T = [(1.135 \text{ kg} \times 35 \text{ cc/kg/hr}) / ((0.3429 \text{ m} \times 0.4822 \text{ m})) \times 1 \text{ atm } (0.21 - 0.03)] \times 24 \text{ hr/day}$$

$$= \mathbf{32{,}034} \text{ cc/m}^2\text{-day-atm}$$

Once the OTR_T requirements for a particular item and package size are determined from equation (1), then the O_2 flow through the breathable surface area of the bag per day ($Flux_{O2\text{-film}}$ in cc/day-atm), is calculated using equation (2):

$$(2) \quad Flux_{O2\text{-film}} \text{ (cc/day-atm)} = OTR_{base\text{-film}} \text{ (cc/m}^2\text{-day-atm)} \times A_S \text{ (m}^2\text{)}$$

In our example, the dimensions of the breathable area of a PVC film used to package 1.135 kg of whole mushrooms are 34.29 cm x 48.22 cm, and the OTR of the base PVC film is 13,300 cc/m^2-day-atmosphere. The $Flux_{O2\text{-film}}$ (cc/day-atm) through the breathable area of the package is:

$$Flux_{O2\text{-film}} \text{ (cc/day-atm)} = (13{,}300 \text{ cc/m}^2\text{-day-atm}) \times 0.1653 \text{ m}^2$$

$$= \mathbf{2{,}198} \text{ cc/day-atm}$$

However, a total $Flux_{O2\text{-Total}}$ of **5295** cc/day-atm is needed for this package as shown below:

$$Flux_{O2\text{-total}} = OTR_T \text{ cc/m}^2\text{-day-atm} \times A_s \text{ (m}^2\text{)}$$

$$Flux_{O2\text{-total}} = 32{,}034 \text{ cc/m}^2\text{-day-atm} \times 0.1653 \text{ m}^2 = \mathbf{5295} \text{ cc/day-atm}$$

Therefore, the majority of $Flux_{O2\text{-Total}}$ must be supplied by the microperforations ($Flux_{O2\text{-MP}}$):

$$(3) \quad Flux_{O2\text{-MP}} = Flux_{O2\text{-Total}} - Flux_{O2\text{-film}}$$

$$= 5295 \text{ cc/day-atm} - 2{,}198 \text{ cc/day-atm} = \mathbf{3097 \text{ cc/day-atm}}$$

According to the present patent application, the number of 150 micron (longest diameter) perforations required in the PVC film that overwraps 1.135 kg mushrooms is equal to:

(3097 cc/day-atm) / (200cc/day-atm per Type II microperforation) = 15 microperforations

For illustrative purposes, one only needs to look at the total open area provided by the microperforations to show how different the Greengrass patent is in relation to the present invention. In the present invention, a total open area for one, 150-micron microperforation, assuming a circular hole, equates to:

$$A = \pi r^2 = 3.14 \times (150/2 \text{ micron})^2 = 17{,}662.5 \text{ micron}^2$$

And, the total open area for the 15, 150-micron microperforations, calculated above, assuming circular holes, would be:

$$A = 15 \times 17{,}662.5 \text{ micron}^2 = 264{,}938 \text{ micron}^2$$

It should be noted that while it may not be readily apparent, employing a single large hole instead of a number of smaller microperforations does not accomplish the desired performance and may also introduce problems with debris and contaminants. That is why the number and size as well as the flow rates are presented in the claims. This is for illustrative purposes to more readily show the extraordinary difference between the Greengrass patent and the present invention.

Greengrass recommends for fresh mushrooms in column 3, line 7-10, " . . . micro perforation pattern, utilizing the arrangement no. of lines/distance lines apart (mm)/pitch of pins (mm)/ size of holes (mm) 05/20/30/60 was used on PVC stretch film overwrapped punnets . . ."

This arrangement indicates that they are using 5 lines (rows) of perforation with the perforations being 60 mm in diameter. A 60 mm perforation is 60,000 microns. That means that each of the Greengrass perforations of 60,000 microns is **545** times larger than the smallest microperforation

size claimed in the present invention, and **150** times larger than the largest microperforation size taught by the present invention.

The total open area of one, 60,000-micron hole for Greengrass, assuming a circular hole, equates to:

$$A = \pi r^2 = 3.14 \times (60{,}000/2 \text{ micron})^2 = 2{,}826{,}000{,}000 \text{ micron}^2$$

As illustrated – the total open area for Greengrass of 2,826,000,000 micron^2 is significantly larger than the 17,662.5 micron^2 open area for one, 150-micron hole of the present invention and also significantly larger than the 264,938 micron^2 open area for 15, 150-micron holes !

Since the flux of a 150-micron hole is 200cc/day-atm, then one of Greengrass's 60,000-micron perforations in the mushroom package would have an O_2 flux of 80,000 cc/day-atm. However, a $Flux_{O2\text{-}MP}$ of 3097 cc/day-atm (see equation 3 above) is only required for the mushroom package, so the Greengrass patent cannot be used to control the optimum atmosphere in the mushroom package at the UC Davis recommended values of 3% O_2 and 10% CO_2.

Greengrass recommendation for mushroom PVC overwrap film is 5 rows of 60,000-micron perforations. Greengrass does not specify how many holes are in each row, but as the calculations demonstrate above, just **one** Greengrass 60,000 micron hole is too large to control the atmosphere at recommended levels – so multiple holes of 60,000 microns clearly will not work according to the present claimed invention

The smallest hole size described in one of the embodiments and claimed by Greengrass is 20 mm (i.e., 20,000 microns) which would produce an O_2 flux of 26,667 cc/day-atm. Again, one, 20,000 micron hole has **8.6** times more O_2 flux than the 3097 cc/day-atm flux required for this mushroom package – so it also cannot function as taught and claimed by the present invention.

Thus, Greengrass does not describe or infer a packaging material that is capable of functioning according to the claimed invention. It simply will not work.

Greengrass also states that the size/number of holes is easily derived by 'scientific testing.' As one skilled in the art, and with 21 years of research experience in the fresh produce packaging industry, deriving the size and number of microperforations needed for each produce type, variety, weight, cut size, and storage temperature is a daunting task. One skilled in the art cannot readily derive the size and number of microperforations for the optimal packaging atmosphere via empirical testing without excessive and undue experimentation. Furthermore, as the teaching of Greengrass is not capable of producing the optimum atmospheric conditions within the claimed range – it obviously is not easily derived by scientific testing.

It should also be noted that Greengrass describes "controlling ripening." Not all produce ripens, but all produce does respire. Ripening is a separate metabolic process that occurs with ripening fruits; most vegetables do not ripen.

The goal in fresh fruit and vegetable packaging is to use MAP/CAP to preserve produce quality by reducing the aerobic respiration rate but avoiding anaerobic processes that lead to adverse changes in texture, flavor, and aroma, as well as an increased public health concern. Aerobic respiration can be defined by the following equation:

$$(CH_2O)n + nO_2 \rightarrow nCO_2 + nH_2O + \text{heat}$$

where O_2 from the air is used to metabolize carbohydrate ($(CH_2O)n$) reserves and in the process, CO_2, and H_2O are produced and heat is generated. Since respiration rates (not ripening as mentioned by Greengrass) must be matched to film gas transmission requirements, the number of variables that would have to be considered in a scientific study of just one produce item at just one weight would be as follows: base film composition and OTR , hole size, hole number, and O_2 flux of each hole size, respiration rate of the produce, age of the produce, contribution of microbial contaminants to respiration rates, temperature of storage, and storage time.

In addition, a reliable and reproducible method of producing hole sizes in the size range that I am claiming is difficult to accomplish without sophisticated, non-mechanical perforating technology. Obviously, Greengrass did not scientifically determine the size and number of holes required by

mushrooms or the other produce items they mention in their patent since Greegrass hole sizes are too large to effectively control the atmosphere inside fresh produce retail packages. The laser hole drilling system of the present invention produces consistent hole sizes in the registered target area for the packaging materials of my invention. Greengrass punches very large holes throughout PVC film, many of which may be wholly or partially occluded by produce within the package.

The packaging material according to the claimed invention is clearly distinguished from Greengrass and the other references. The hole sizes of Greengrass cannot function according to the parameters of the claims and the Greengrass holes are not in a registered target area.

The undersigned declares that all statements of his own knowledge made herein are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application of any patent issuing thereon.

Respectfully submitted,

Elizabeth Varriano-Marston

Elizabeth Varriano-Marston

8/6/04

Date

Applicant's Attorneys:
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Mushroom

Recommendations for Maintaining Postharvest Quality

Trevor V. Suslow and Marita Cantwell

Department of Vegetable Crops, University of California, Davis,CA 95616

Maturity Indices

Agaricus bisporus mushrooms (Button Mushrooms) are harvested by maturity and not by size. Maturity is reached when the caps are well-rounded and the partial veil is completely intact. The stipe (stalk) should have a small length to thickness ratio. Stipe length should be sufficient to permit some trimming without cutting flush to the veil.

Quality Indices

Good quality, fresh '*Agaricus*' mushrooms should be white to dark brown. White forms are most prevalent. Uniform, well rounded cap with a smooth glossy surface and fully intact veil are indicators of best quality. Stipes are straight and glossy in appearance with an even cut edge. Cleanliness (minimal growth medium residue) and absence of browning or other discoloration are additional quality factors. Visible, open gills and absence of a stipe are negative factors.

U.S. grades are No. 1 and No. 2. Sizes range from Small {Button} (1.9 - 3.2cm / .75 - 1.25 in.), Medium (3.2 - 4.5cm / 1/25 - 1.75 in.), to Large (4.5 cm / 1.75 in. and larger) measured as cap diameter. Grades discriminate for maturity, shape uniformity, cleanliness and trim quality.

Agaricus mushrooms are not significantly impacted by exogenous ethylene.

Responses to Controlled Atmospheres(CA)

Extended storage (~12-15 days) in 3% O_2 and 10% CO_2 at 0°C has been Controlled demonstrated. Elevated CO_2 at 10-15 % (typically 10%) in air is beneficial in Atmosphere (CA) preventing decay and reducing the rate of blackening of the stipe and gills. The beneficial effect is most pronounced if temperatures cannot be maintained below 5°C (41°F). Short exposure to higher CO_2 concentrations (20 %) is safe and beneficial only if temperatures can be maintained at 0° - 1°C (32° - 34°F).

Improper control of controlled atmospheres or improper packaging can rapidly lead to depletion of oxygen resulting in conditions favorable for *Clostridium botulinum*. For this reason, primarily, the use of CA and MA is not common.

Physiological & Physical Disorders

Mushrooms will continue to develop after harvest which is why low & Physical temperature postharvest management is critical. Common disorders include Disorders upward bending of caps and **opening of the veil**.

Mushrooms are easily **bruised** by rough handling and develop patches of browning discoloration.

Freezing injury (water-soaked appearance leading to extreme softening) will likely result at temperatures of -0.6°C (30.9°F) or lower.

Signs of **CO_2 injury** are blackening and pitting.

Pathological Disorders

Disease is generally not an important source of postharvest loss in comparison with physiological senescence and improper handling or bruising. Diseases, such as Bacterial Blotch, and spoilage due to other

Pseudomonas spp. are generally eliminated during the harvest or sorting phases although development of patches of decay can occur with elevated temperature or extended storage.

Special Considerations

Rapid forced-air cooling soon after harvest is strongly recommended. Center-loading during shipment promotes good cooling-air circulation necessary for this commodity. Good arrival following surface transportation is enhanced when trailers are equipped with 'air-shocks' suspension. *Agaricus* mushrooms are reported to acquire strong odors, such as onion, in mixed loads or short term storage.

Search PTRIC (enter search words) Search

UCDAVIS

Postharvest Technology Research Information Center
Department of Pomology
University of California
One Shields Ave., Davis, CA 95616-8683
Send comments and questions to
postharvest@ucdavis.edu

Produce/ProduceFacts/Veg/mushroom.shtml updated June 10, 2002

Optimum Temperature

0° - 1.5°C (32° - 35°F) Storage life is typically 5-7 days at 1.5°C(35°F) and 2 days at 4.5°C (40°F).

Optimum Relative Humidity

95-98 %; High relative humidity is essential to prevent desiccation and loss of glossiness. Drying is correlated with blackening of the stipe and gills and curling of the cap. Commonly mushrooms are packed and shipped in cartons with a perforated overwrap to maintain high humidity.

Rates of Respiration

Respiratory Quotient $= \frac{[CO_2]}{[O_2]}$

Temperature °C	°F	ml CO_2/kg·hr
0	32	14-22
5	41	35
10	50	50
15	59	NA
20	68	132-158
25	77	NA

Since RQ = 1 $\Rightarrow$ O_2 RR equivalent to CO_2 RR

To calculate heat production multiply ml CO_2/kg·hr by 440 to get Btu/ton/day or by 122 to get kcal/metric ton/day. NA= not applicable

Rates of Ethylene Production

>0.1μl / kg·hr at 20°C (68°F)

Responses to Ethylene

THE WILEY ENCYCLOPEDIA OF PACKAGING TECHNOLOGY

MARILYN BAKKER, Editor-in-chief

DAVID ECKROTH, Managing editor

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ket (see Films, stretch). It features good stretch and outstanding tack and optics and is offered in thicknesses of 0.65–2.0 mil (16.5–51 μm). As textile and rug-roll overwraps, they provide both shipment protection and merchandise visibility. When formulated with weather-resistant plasticizers and uv screens, they provide very good outdoor weatherability, and pigmented versions conceal tempting merchandise.

One of the newest applications for oriented flexible PVC is in the bundling of multiple aseptic packages (see Aseptic packaging). Ranging in thickness 0.75–1.50 mil (19–38 μm), this film provides a relatively high shrink at low temperatures, resulting in a firm, unitized pack. PVC seals easily, offers good economics, and merchandising appeal. Heavy-gauge (2.0–7.5 mil or 51–191 μm) flexible PVC has been used as a component of windowed cards for about 20 years. Toughness, formability, good dielectric sealability, and merchandising appeal are important qualities. Hardware and electrical items, flashlights, and automobile parts are typically packaged this way.

An interesting nonpackaging application is the use of high-clarity, glossy flexible PVC films as laminating films for paperback book covers. The combination of low cost, flexibility (resists cold crack) and adaptability to the Trio-Bond laminator (uses water-based adhesives, no solvents or heat) have made PVC competitive with acetates and lacquer coatings.

Physical Properties

Not surprisingly, of all the PVC additives, the type and level of plasticizer used in a flexible PVC film exercises the most influence over its physical properties. Its most obvious effect is on modulus (stiffness). PVC film can be stiff, like cellophane; but by simply adding plasticizer, one can produce a film that is nearly elastomeric. Some plasticizers are more efficient than others, which means that one can use less of a more efficient plasticizer to achieve a specific modulus reduction. A discussion of the selection process for some specific flexible PVC-film applications and the resultant film properties is germane to packaging applications.

Flexible PVC film to be used as a wrap for fresh red meat must offer good stretch characteristics (low modulus), high oxygen permeability, moderately low water vapor transmission rate (WVTR), good low temperature properties, heat sealability, and resilience. It must also be very transparent, glossy, and reasonably priced, and it must be manufactured from FDA-sanctioned raw materials. The first plasticizer to

Table 2. Properties of 1-mil (25.4 μm) Flexible PVC Film

Property	ASTM test		Flexible PVC meat package stretch type	Flexible PVC dispenser film	Flexible PVC shrink bundle film
specific gravity	D 1505		1.23	1.27	1.3
yield, in.²/(lb·mil) [m²/kg·mm)]			22,400 [1,254]	21,600 [1210]	21,400 [1198]
haze, %	D 1003		1.2	1.0	2.5
light transmission, %			>90	>90	>90
tensile strength, psi (MPa)	D 882	MD	5,000 (34.5)	5,500 (37.9)	18,000 (124)
		XD	4,500 (31)	5,500 (37.9)	5,500 (37.9)
elongation, %	D 882	MD	275	300	90
		XD	375	325	275
tear strength, gf/mil (N/mm) initial		MD	300 (116)	325 (125)	335 (129)
propagating	D 1922	XD	450 (174)	500 (193)	575 (222)
water absorption, 24 h, %	D 570		0	0	0
change in linear dimensions at 212°F (100°C) for 30 min, %	D 1204	MD	na	na	45
		XD			10
service temperature °F (°C), range			−20–150 (−29–66)	0–150 (−18–66)	10–150 (−12–66)
heat-seal temperature °F (°C), range			290–320 (143–160)	290–340 (143–171)	280–330 (138–166)
oxygen permeability cm³·mil/(100 in.²·d·atm)[cm³·μm/(m²·d·kPa)], 73°F (23°C), 50°rh 23C, 50% rh	D 1434		860 [3342] = 13,300 cc/m²-day-atm	340 [1321]	na
water vapor transmission rate: g.mil/(100 in.²·d) [g·mm/(m²·d)], 100°F (38°C), 90% rh			16 [6.3]	10 [3.9]	na
COF, face-to-face	D 1894				0.2
back-to-back			1.0	1.0	0.2
test conditions: 73°F (23°C), 50% rh					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: VARRIANO-MARSTON, Elizabeth — Group Art Unit: 1772

Serial No. 09/877,757 — Examiner: Patterson, Marc

Filed: 06/08/2001 — Atty. Dkt. No: MARS93-DIV

For: REGISTERED MICROPERFORATED FILMS FOR MODIFIED/CONTROLLED ATMOSPHERE PACKAGING

To: Box Non-Fee Amendment
U.S. Patent and Trademark Office
P.O. Box 2327
Arlington, VA 22202-0327

Fm:

Dear Honorable Commissioner:

This declaration is offered in support of the above application for patent.

RULE 132 DECLARATION OF ELIZABETH VARIANO-MARSTON (37 CFR 1.132)

I am the sole proprietor of EV Marston & Associates, a successful New Hampshire business that provides consulting services to many companies throughout the United States. I primarily develop breathable packaging materials for fresh produce (hereafter, fruits, vegetables, flowers, herbs), and consult with fresh produce companies on packaging and quality issues. For 11 years, I published a monthly newsletter, Produce Technology Monitor, a widely read newsletter in the fresh-cut produce industry. According to the trade, this newsletter is ". . . the bible for technical processing questions."

I have extensive experience developing breathable packaging materials for fresh produce. In this connection, I have developed polymer compositions for specific end uses, and developed breathable patch technologies and microperforated films - all for use in the fresh produce industry. These breathable packaging materials are currently being used by businesses to package fresh produce for quality retention and shelf life extension.

I am a member of a number of professional organizations, in or related to the food industry, including Institute of Packaging Professionals, Women in Science, Institute of Food Technologists, Produce Marketing Association (PMA), and International Fresh-cut Produce Association (IFPA). In addition, I have served on the Technical Committee of the IFPA, presented talks on produce packaging at national IFPA and PMA meetings, and served as an expert witness in one arbitration (*Dominos Pizza v. Fresh Prep*) and one civil proceeding (*Del Monte Corporation v. Del Monte Fresh Produce Company*) regarding fresh produce definitions, quality and fresh produce packaging. Based on my testimony for Del Monte Fresh Produce Co., the company won their case and was able to continue their start-up business in fresh-cut fruit, a business that is worth many millions of dollars for the company today

I began working on packaging films for fresh produce in 1983 while employed by Hercules, Inc. (Wilmington, DE), a major manufacturer of packaging films. From 1984 -1990, I was part of a Corporate R&D team (and became project manager for the team) that developed the first breathable packaging system for high respiring fresh produce items. The system consists of a permeable patch over a hole (aperture) in a package. In 1989, this packaging system won the R&D 100 Award and the DUPONT Award for innovations in food packaging.

In 1990, I began a consulting company to assist fresh produce companies with package development and specifications. In 1992, I began conducting research on the use of microperforations for controlling the atmosphere inside fresh produce packages.

<u>Background of the Invention</u>.

In the early to mid-1990's Courtaulds (UK) was beginning to market laser microperforated films to European companies. However, many produce companies that had tried these laser perforated films were unsatisfied because of inconsistencies in the oxygen transmission rates of the films. Inconsistencies were caused by Courtaulds' inability to reproducibly place the same number and size of microperforations in each bag and by blockage of the perforations by produce inside the bag, by marketing labels placed on the package, or by package-to-package contact that caused occlusion of the microperforations when bags were placed in case cartons for shipping. Furthermore, the sizes of the microperforations were so small that it was essentially impossible for the fresh produce

packer to know where the perforations were so they could avoid occluding them with produce and/or labels. In fact, the produce packer did not have an easy way to verify that the films they received were microperforated at all. The difficulties were related to the microperforation process employed by Courtaulds, wherein their process produced rows of very small (averaging 50 micron) microperforations along the entire machine direction of the film web.

Knowing the drawbacks and disadvantages of the Courtaulds' microperforated films, I decided that one remedy would be to increase the microperforation size and to <u>register the microperforations in a small identifiable area</u> (a defined area or window usually less than 2 sq in.) typically in the uppermost regions of the package by coupling lasers with optical sensor technology. Such a system would allow the customer to easily locate the microperforations for verification and prevent occlusion of the microperforations by product or labels.

The other problem with Courtaulds' microperforated films was that they were not specifically designed for the varying respiration rates of different fresh produce types and weights. The same microperforated film was often recommended for produce items of widely varying respiration rates. For example, they used the same perforated film for packaging the same weight broccoli and cauliflower, produce items that have a 2-fold difference in respiration rates. My vast database of knowledge on respiration rates of produce coupled with a method to calculate the number and size of microperforations needed to establish an optimum oxygen and carbon dioxide atmosphere inside the package made it easy to match the packaging material oxygen transmission rates with the respiration characteristics of each produce item and use that information to make and register the microperforations using laser technology.

<u>Present Invention</u>

One aspect of the invention relates to <u>registered microperforated packaging materials for use in modifying or controlling the flow of oxygen and carbon dioxide into and/out of a fresh produce container (flexible, e. g. bags, or semi-rigid), where the microperforations are specifically tailored in size, location and number for the specific produce</u>. The packaging system designates specifically tailored microperforated containers for particular fresh produce to optimally preserve the produce. The method of making the registered microperforations on the packaging material consists of using

a CO_2 laser and a sensor or timer mechanism in conjunction with processing that calculates the appropriate number/size of the microperforations to reach desired O_2 and CO_2 concentrations inside the fresh produce container during cold transport, storage, and display. Examples of the microperforated films are provided herein to show the location, size and number of microperforations for the various respiring produce. Exhibit A is included to show the differences between the De Moor (U.S. Pat. No. 6,013,293) microporous patch technology and the microperforated packaging as described in my patent application. Clark (U.S. Pat. No. 6,376,032) is yet another microporous packaging invention – which is the equivalent of comparing apples to oranges – as they are different technologies in their own field.

Exhibit A – is a Markon broccoli floret bag made of 2 mil PE base film with the <u>microporous</u> patch affixed to the film as taught by the De Moor patent. The patch allows the air to escape through the apertured cover member.

Exhibit B – shows the Markon microperforated 2 mil PE bag for broccoli florets according to the present patent application with microperforations of a specific size/number according to the optimal respiration rate of broccoli and placed in a target area in the uppermost portion of the bag.

Exhibit C – illustrates the target area as described in the present application where the microperforations are registered by the eye mark on polyethylene coextruded roll stock.

Exhibit D – shows the old technology with <u>microperforations not registered</u> and merely placed in a linear path along the entire film web. Once the bag is formed from this web, some portion of the non-registered microperforations are subject to occlusion and therefore, the rate of oxygen transmission is not consistent from bag to bag.

Exhibit E – shows microperforations in a target area according to the present invention to minimize the effects from occlusion on bags made from polyethylene monoweb.

Exhibit F – bags made of 1.2 mil BOPP (biaxially oriented polypropylene) with a heat seal coating with the microperforations in a target area according to the specifics of the present invention.

Exhibit G – bags made from seven-layer coextruded polyethylene with microperforations in target area according to the present invention.

Exhibit H – polypropylene/polyethylene laminated bag with targeted microperforations according to the present invention

Exhibit I – heat-sealable lidding films with microperforations according to the present invention.

Exhibit J – semi-rigid lid with microperforations in a targeted location to avoid occlusion by the center label.

The Exhibits visibly demonstrate the use of the microperforations with varying size/number that are placed in certain areas to avoid occlusion. The Exhibits illustrate the microperforated technology used on a number of differing materials including semi-rigid containers and heat-sealable lidding films.

Copying by the Inventive Subject Matter after product in use:
Pursuant to a license agreement with Roplast Industries (Oroville, CA), my proprietary microperforation laser drilling technology and microperforation specifications were used for a variety of produce items. Again, as part of the licensing agreement, EV Marston instructed Roplast on how to calculate the size and number of perforations required for specific fresh produce items to obtain the desired oxygen and carbon dioxide levels inside the packages. In return for my proprietary technology, Roplast was to pay for the use of the technology once microperforated materials were made and sold.

After Roplast terminated its business agreement with EV Marston, EV Marston obtained microperforated bags from New Star Fresh Foods (Salinas, CA) produced by Roplast using the laser equipment and proprietary information transferred to them by EV Marston. The microperforations were registered within a 2 in^2 area and had diameters within the size range that was specified for them by EV Marston. Based upon careful examination and inspection, it was conclusively

determined that Roplast was using proprietary technology belonging to EV Marston to market registered microperforated film with Landec, EV Marston's competitor. Litigation counsel was retained and notification was sent to Roplast. As a result of the steps taken by EV Marston, Roplast suspended production of any microperforated materials.

EV Marston has also discovered that the present owner of Courtaulds' microperforated films, Danesco, is registering microperforations on films made in the UK and sold in the U.S. The old Courtaulds' films had the microperforations continuous along the machine direction of the film. These old films were made before 2000, and before the EV Marston microperforated materials were being used in the industry. In addition, another potential infringer has been detected in the marketplace. Notification was sent to this company by legal counsel and we are presently waiting for a response.

Patent Protection

A provisional patent application was filed May 4, 1999 claiming the proprietary technology developed by EV Marston, which was protected from disclosure by the various agreements. The provisional application was filed within one year of any sale, offer for sale, public use or other statutory bars. It was filed before any of the initial efforts that began at Roplast in developing the invention. The subsequent Utility patent applications cover the inventive subject matter including additional proprietary technology developed. On Aug. 27, 2002, the first Utility Patent Serial No. 6,441,340 issued.

Response to Office Action dated 7/18/2002

There were several areas in the Office Action that requested further information on the technology related to the present invention. The accompanying materials are included as an aid to gain a better understanding of the technology related to packaging and the terms used in the art. They are also used to distinguish my invention from the state of the art.

Figure 1

Figure 1 a, b shows the microperforated film in a drawing perspective illustrating that the microperforations go completely through the materials and thereby provide a direct path between

the internal bag atmosphere and the external atmosphere. The size/shape/number of the microperforations controls the rate of gas interchange between the internal and external atmospheres. Figure 1c is an actual light micrograph of a 120 micron diameter hole made in a packaging film by the laser.

Figure 2

This figure helps to show the microporous films described in the prior art. In particular, note that there are no direct holes connecting the inner atmosphere to the external atmosphere. Instead, a torturous pore structure exists, resembling a sponge with a network of interconnecting pores. Gas flow through this porous structure, with its interconnecting polymer layers, occurs by a process of diffusion through each polymer layer that makes up the walls of the pores, until it finally reaches the other side of the film.

The Continuation of Figure 2 illustrates a cross sectional view of the microporous film indicating the convoluted path along the layers and voids in the film.

Text Articles

Heal-Sealable materials – *The Wiley Encyclopedia of Packaging Technology*, published by J. Wiley & Sons; pages 458-459, section entitled Multilayer Flexible Packaging
As noted in the description, the terms 'heat-sealable and 'sealable films' are well known and depicted in the prior art. Heat sealing refers to the melted sealing of packaging material through heat and pressure. Various techniques and products are described in the prior art.

Lidding – *The Wiley Encyclopedia of Packaging Technology*, published by J. Wiley & Sons; pages 440-442, section entitled Lidding
The lidding process refers to sealing containers, such as semi-rigid containers, to seal the contents within the container. A further description is detailed in *A Handbook of Food Packaging*, pages 136-137. The lidding processing and general configuration is shown in the thermoformed packs of Figure 4-46.

Semi-Rigid - *The Wiley Encyclopedia of Packaging Technology*, published by J. Wiley & Sons; pages 201-203, section entitled Coextrusions for Semirigid Packaging

Semi-rigid structures are known in the industry and one is further provided as an exhibit herein.

Test Data Comparisons

Bananas. The effectiveness of packaging materials made by the inventor's microperforation method (tradename = Micro-CAP™) in extending the shelf life of fresh produce has been compared to films commonly used in the fresh produce industry. Attached is a report by Mr. Manny Zantua from Aug. 1, 2001 (LETTERS 4,5), Del Monte Fresh Produce Company, on the shipment of bananas in Micro-CAP bags with the optimum size and number of microperforations registered in the uppermost 1/3rd of the bag compared to bananas packed in industry standard bags (Banavac™ bags) that are not perforated. The ship tests showed that bananas packed in Micro-CAP bags not only eliminated the need to tear open each bag before initiating ripening with ethylene gas, but also the microperforated bags delayed the color development by 2 days, i.e. control bananas in Banavac bags were color stage 3 (part green, part yellow) after 5 days while bananas in Micro-CAP bags were stage 3 after 7 days. In early studies with Del Monte, their VP of R&D, Dr. Daniel Funk, was surprised by the results of trials on the inventor's microperforated bags, as he writes in a hand-written note at the bottom of a Jan. 4, 1999 memo from Mr. Zantua (LETTER 1) and a Jan. 12, 1999 letter to EV Marston (LETTER 2). These later two letters provide further evidence from a scientist with extensive experience in produce packaging of the unexpected results obtained from the microperforation system of the present invention.

Green Onions. In developing the specifications for a particular produce items, preliminary tests are necessary to determine the optimum oxygen transmission rate requirements of the produce. A series of such tests were conducted on whole green onions packaged at Boskovich Farms (Oxnard, CA), and the data are summarized in the attached report (LETTER 3) from SOCOPAC, a sales agent working with one of the plastics converters who is licensing my microperforation method. The results show that green onions packaged in Micro-CAP liner bags that were designed with lower oxygen transmission rates (Micro-CAP B and C) maintained good quality longer than green onions packed in mechanically perforated bags.

The inventor's packaging method has also proven to be more effective than other packaging materials in extending the quality and shelf life of such items as soul greens (collards, kale, mustard, turnips), broccoli florets, cauliflower florets, and sweet cherries. I am intimately familiar with the prior art patents and commercial products and process, including De Moor US 6,013,293. To the best of my knowledge, I was the first to design and implement a working microperforation system, process and microperforated product with registered target area in the industry.

The undersigned declares that all statements of his own knowledge made herein are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application of any patent issuing thereon.

Respectfully submitted,

Elizabeth Varriano-Marston

Elizabeth Varriano-Marston

10/16/02

Date

Applicant's Attorneys:
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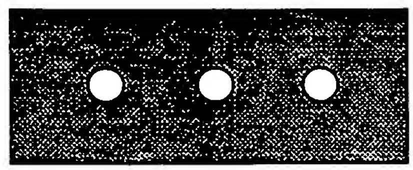
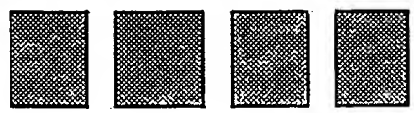
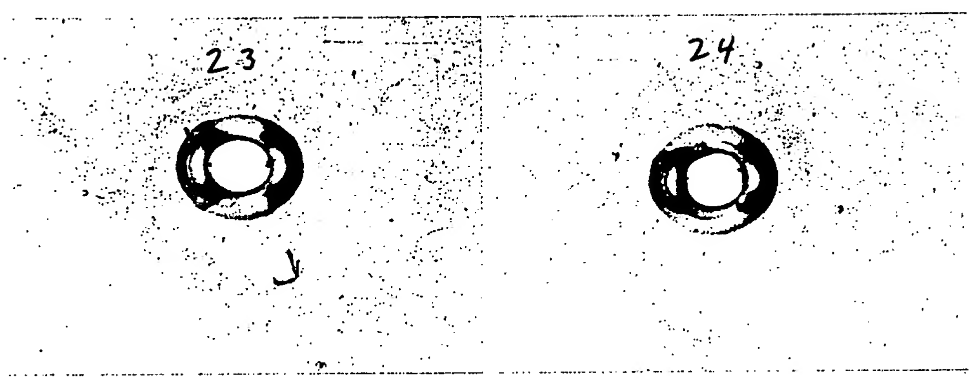
Figure 1. Structure of a typical microperforated film as described in my invention: (a & b) are drawings showing a surface view (a) and a cross sectional view (b). Light micrographs of actual 120-micron diameter microperforations in a polypropylene/polyethylene laminate are shown in (c).



(a)

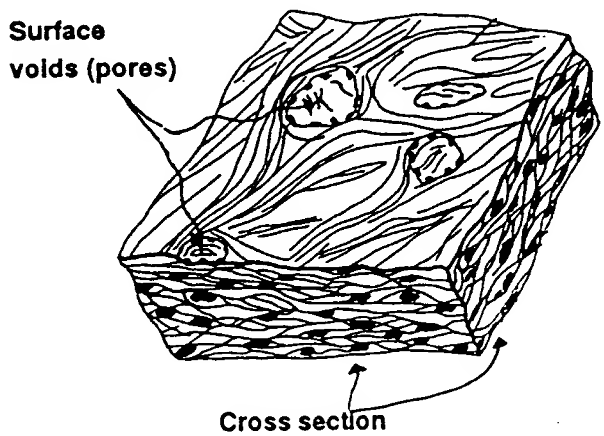


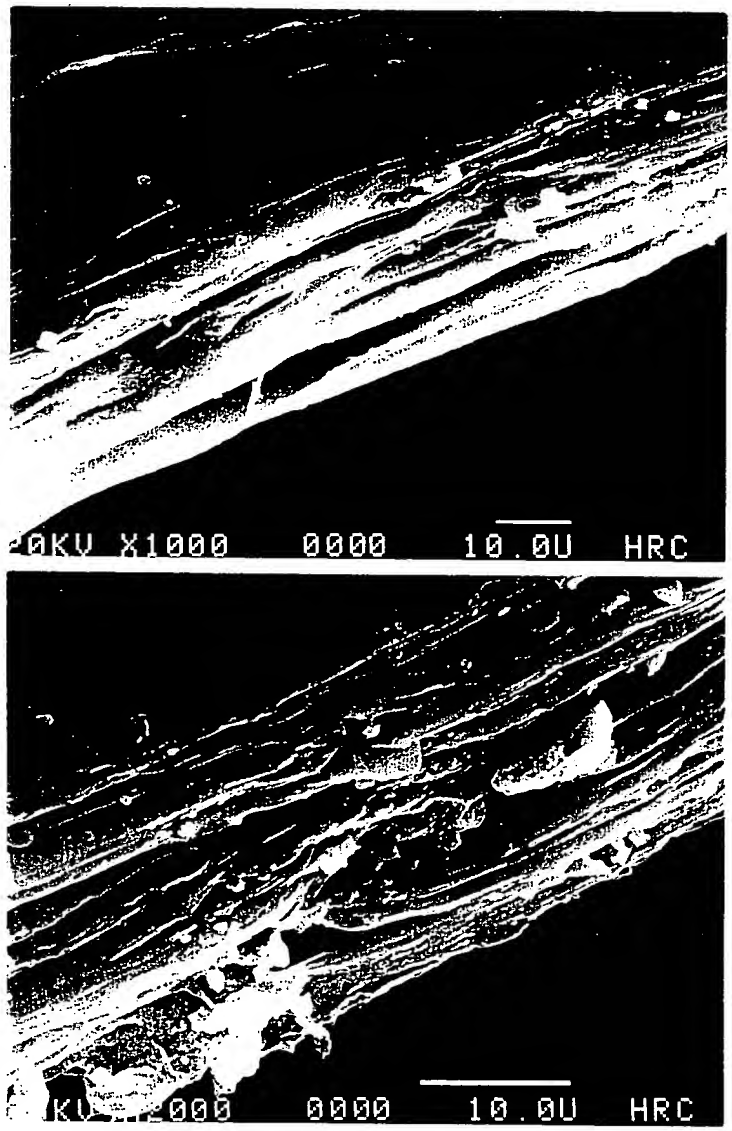
(b)



(c)

Figure 2. Drawing of a microporous film showing irregular void (pores) in the surface. The cross section reveals a tortuous pore structure with a network of interconnecting pores. Dark particles in the cross section are filler particles, typically $CaCO_3$ or silica. From U.S. Patent 3,903,234, 1975. Scanning electron micrographs of an actual cross section of this type of microporous film are attached.





Continuation of Figure 2:

Scanning electron micrographs (1000x and 2000x) showing the surface and cross section of a typical <u>microporous</u> film. Note that unlike microperforated films, the micro-voids or pores in microporous film are not capillary in structure, i.e., they do not follow a straight path through to the other surface of the film.

materials provides a wide degree of formulating flexibility to achieve adhesion to different substrates, heat resistance, chemical resistance, and barrier to migration of components of some products. Because of this formulating flexibility, less demanding applications can be served by lower-cost formulations.

Waterborne acrylic emulsion adhesives are being used in greater quantities than before to achieve compliance with EPA regulations (see Acrylics). Waterborne PVDC adhesives are also used to some extent, although efforts to develop PVDC adhesives that provide both good adhesion and good oxygen barrier have not been successful. These two characteristics reflect direct opposites in the chemistry of these materials. One can expect good, but not excellent, adhesion and good oxygen barrier with selected PVDC adhesives.

Extruded adhesives. Polyethylene and ethylene copolymers are widely used as laminating adhesives. They provide adhesion between substrates, add bulk to the lamination, and contribute to moisture barrier in the absence of foil. Polyethylene, EAA, EMA, EMAA, and ionomers are all used, depending on the substrate, bond strengths required, and end use. Polyethylene often requires the use of an adhesion promoter on one or both substrates. Nonpolar PE does not adhere to the polar surfaces of most traditional laminating materials. PE extrusion lamination is accomplished by using high extrusion temperatures to oxidize the surface molecules to some extent, which introduces a polar configuration. The polar ethylene copolymers adhere well to a variety of substrates. EAA, EMA, and ionomers have particular affinity for foil.

Waxes and wax blends. Paraffin or microcrystalline waxes, or both, are used for special applications where high bond strengths and heat resistance are not required (see Waxes). These materials can be modified by the addition of low molecular weight PE, EVA, or other resins and resin additives to increase adhesion, hot tack, and stiffness or softness of the lamination. They are generally applied to one of the substrates by gravure–cylinder application (see Coating equipment) at temperatures high enough to reduce the viscosity of the material within a range that can be adequately controlled by gravure. The second substrate is brought in contact with the hot wax under pressure, and the composite is chilled. If one of the substrates is very porous, the wax is chilled on the primary substrate before the combining operation. Examples of the use of wax as an adhesive include AF/wax/tissue chewing gum wraps; CELLO/wax/AF–modified wax for cheese packaging; and glassine/modified wax/AF/PE for a tobacco pouch.

Miscellaneous adhesives. A small number of laminations utilize the thermoplastic nature of a coating, which is a component of one or both substrates. For example, two films that have a heat-sealable PVDC coating can be joined with heat and pressure, or aluminum foil can be laminated to a prewaxed tissue by the application of heat and pressure. Printing inks can also serve as adhesives if the bond-strength requirements are limited. This technique is used in some PE–PR–PE laminations for chub packs (see Chub packages).

Package Closure

The methods of package closure are heat sealing, cold sealing, and glue sealing.

Heat sealing. The primary method of closing multilayer packages is heat sealing (see Sealing, heat). The inner component of the structure is a thermoplastic material that softens with application of heat and solidifies when the source of heat is removed.

Cold sealing. Heat is not necessary if the coating is a modified-rubber-based material that seals to itself with the application of pressure, but not to other materials. These are called cohesives, or cold-seal coatings (see Adhesives). They can be applied over the entire material surface, but they are most commonly applied as a peripheral coating at the edges of the material in register with a printed design on the package face. This is done to reduce materials cost, but also because cohesive materials have very high coefficients of friction. Reducing the covered surface area facilitates movement over the packaging equipment. Lap-seal applications are not feasible with cold seals because the cohesive would have to be coated on both sides of the material, which would result in sealing in the rolls. Care must be exercised in the processing of cold seal materials to reduce the possibility of off-odors affecting the product. Cold-seal materials are used to package ice cream, confections, and candy bars that would be damaged by heat.

Glue sealing. This involves the application of an adhesive (glue) to specific areas of the packaging material on the machine that forms the package (see Adhesive applicators). Glue sealing is not widely used for multilayer flexible packaging, except for products that do not require continuous seals and only on paper-containing packaging materials. The adhesive is partly dried by absorption of the water from the glue into the paper.

Heat-Sealable Materials

The success of multilayer flexible packaging is directly related to the use of heat sealing, which involves positioning the faces of the materials so they will be combined by melted sealant upon application of sufficient heat and pressure. This is dependent on the solidification of the sealant material when the heat is removed.

Heat-seal coatings. Heat-seal coatings are generally defined as coatings applied from solvent solutions or water emulsions. The coating weight is generally between 1 and 5 lb/3000 ft^2 (0.45 and 2.3 kg 278.7 m^2). Coatings on films and paper can be vinyl acetate–vinyl chloride copolymers, nitrocellulose, acrylics, or PVDC. PVDC coatings can provide barrier as well as heat seal (see Vinylidene chloride copolymers), but those formulated for maximum barrier properties are not heat-sealable. They are used as inner components of a lamination or on the outside surface. Vinyl chloride–vinyl acetate copolymers have been used for some time as heat-seal coatings on films and foil. They also protect aluminum from corrosive agents present in many products. Structures of this type are generally used as lid stocks (see Lidding) for rigid containers or as the closure portion of pharmaceutical pill packages. Emulsion coatings of low molecular weight EVA copolymers are used as the heat-seal component of lid stock for cups. Other heat seal coatings include waxes, nitrocellulose, eg, on cellophane, and acrylics, eg, on BOPP.

Waxes. Wax heat-seal coatings on paper also provide moisture barrier (see Waxes). Paraffin and microcrystalline waxes are used for sealing, as well as blends of the two. Waxes are available with a range of melting points, and care must be taken to choose a wax or blend that will achieve the desired sealing characteristics without blocking or sticking in the rolls. Waxes and wax blends can be modified with low molecular weight LDPE to harden them slightly. This makes them

less susceptible to blocking, and it also strengthens the heat seal. Low molecular weight EVA added to waxes tends to improve the hot tack, seal strength, and resistance to blocking in roll form. Other tackifiers can be added to make the seals more tenacious. Wax coatings are sometimes applied on the packaging line. Some carton liners are heat sealed through the use of a wax stencil applied on the packaging machine to supplement the wax contained in the packaging material or to areas where no wax sealant is applied by the materials producer. This is primarily done on the foil surface of AF/wax/tissue laminations.

Hot melts. Hot melts, applied in molten form, utilize a number of thermoplastic resins, waxes, and modifiers. They are applied as coatings over the entire packaging material surface or in a pattern, registered with printing, to effect positive package closure. Hot melts can be formulated with one of a number of resins as the principal component, eg, ethyl cellulose, nitrocellulose, EVA, or polyamide.

Heat-sealant films. Most heat-sealant films are polyolefins.

Low density polyethylene. The most common heat sealant is low density polyethylene. This is not a single product, but a family of materials that vary in density, melt index, and molecular weight distribution (see Polyethylene, low density). As density increases, sealing temperature, heat resistance, strength, and stiffness increase, and sealing range, clarity, and barrier decrease. The differences are relatively minor within the range of low density polyethylenes.

Melt index has a more significant effect. As melt index increases (molecular weight decreases), sealing range and clarity increase, and sealing temperature, heat resistance, strength, stiffness, and chemical resistance decrease. Barrier properties are not affected. In general, polymers with melt index from 0.24 to 5.0 are used for manufacturing blown films, and those from 2.0 to 30.0 for cast films and extrusion coating. Molecular weight distribution (MWD) is a function of the polymerization process. Narrow MWD resins have a narrower sealing range than broad-MWD resins.

The range of polyethylenes provides great latitude in tailoring structures to meet package/product requirements. They are incorporated through film lamination, extrusion coating, or as components of coextrusions. The density of linear LDPE is within the range of conventional LDPE, but some of the properties tend to be more like HDPE. Compared to LDPE, for example, the heat-seal initiation temperature and physical strength of LLDPE are much higher. In many cases, LLDPE film can be thinner than an alternative LDPE film. LLDPE resins can be blended with conventional LDPE in any ratio. The heat-sealing and physical characteristics of films made from blends range between the properties of either material. Processing of blends is much less demanding than processing straight LLDPE. LLDPE can also be blended with EVA copolymers to further enhance sealing properties.

Medium density polyethylene. MDPE is sometimes used as a component of multilayer structures where slightly higher heat resistance or barrier properties are desirable. MDPE is used as the inner component of boil-in-bag material and for some medical devices subjected to retort sterilization. LLDPE blends are replacing MDPE in many of these applications.

High density polyethylene. HDPE (see Film, high density polyethylene; Polyethylene, high density) is rarely used as the sealing medium in flexible packaging because of its high seal-initiation temperature and narrow seal range. Where heat resistance and high strength are required in special applications, eg, medical products, a rubber-modified HDPE is used.

Polypropylene. PP (see Polypropylene) is not widely used as a heat sealant except as a component of coextrusions used in special market areas. Polypropylene copolymers are used in coextruded BOPP films as the heat-sealant component and in retort pouch structures (see Retortable packages).

Ethylene copolymers. Copolymers of ethylene and vinyl acetate (EVA), acrylic acid (EAA), or methacrylic acid (EMAA have properties that are very different from LDPE–LLDPE (see discussion under Ionomers). Each of the copolymers is available in a range of comonomer percentages. EVA is available with 4–30% vinyl acetate, for example. The acid copolymers, EAA and EMAA, provide excellent adhesion to metals, as do ionomer-modified acid copolymers. With increasing comonomer content, clarity and heat-seal range increase; crystallinity, stiffness, and heat-seal temperature decrease. They can all be used in multilayer structures as films that are laminated, as extrusion coatings, or as components of coextrusions. The copolymers cost more than LDPE and are used only if their specific properties justify the additional expense.

In summary, the variables considered when choosing a polyolefin sealant film are density, melt index, molecular weight distribution, homopolymer or copolymer, comonomer and percent comonomer, blend of resins, and film thickness. All of these materials can be modified with slip and antiblock additives, and they can be pigmented. Care must be exercised when using some of the copolymers if the packaged product is susceptible to picking up off-odors or flavors.

Sealing Properties of Heat Sealants

Seal-initiation temperature. This is the lowest temperature at which a seal can be achieved. Activation temperatures range from relatively low for waxes to relatively high for MDPE and HDPE. In multilayer structures, this involves not only the melting point of the sealant, but the conductivity of the other components of the structure. Most flexible materials are poor thermal conductors, which means that heat transfer is not rapid. In sealing operations in which the heat is applied to the outer surface of the material, more often from only one side, the amount of heat required is increased because of the insulation effect of the components. Aluminum foil is an excellent conductor, but because it transmits the heat laterally and takes the heat away from the seal area, more energy is necessary to effect a seal. Heat-seal initiation temperatures are determined by establishing a standard dwell time and pressure, and then progressively increasing the temperature until a seal is obtained. Information obtained in this way provides a starting point for establishing packaging machine conditions.

Seal range. This is the range of temperatures at set conditions of pressure and dwell time in which effective seals can be obtained. The seal-initiation temperature is at the bottom of the range; the top is the highest temperature at which a satisfactory seal can be obtained without deterioration of the seal or the structure.

Hot tack. Hot tack is the resistance to separation of a seal immediately after removal of the pressure and temperature of sealing. Waxes generally have poor hot tack; ethylene copolymer films, particularly ionomers, have good hot tack. This feature is very important in VFFS operations, where the product is dropped into the formed tube while the seal jaws are closed. The full weight of the product is then on the hot seal

tainers as against paper, plastics, or metal packagings. This is one area where U.S. legislation has influenced the EEC considerably, especially legislation in Minnesota, Oregon, and Washington.

Proposed directive on beverage containers. The European Parliament spent 1982 discussing the EEC Commission's proposals on beverage containers without getting very far. The issue has also become a political football with voting along party lines. The Left broadly supports the directive, and the Right opposes it. Votes swing either way, depending on who is present at the meeting in question. The Council of Ministers discussed the directive in June 1983, when seven member states voted in favor of it, two against (UK and Ireland), and the Italians were undecided.

Document 1-1187/82 drawn up on behalf of the committee on the Environment, Public Health, and Consumer Protection of the European Parliament calls on the Parliament to forward a new resolution to the Council and Commission proposing that the directive be replaced by a recommendation. The draft directive is faulted on several points, including failure to provide a basis or evidence for the proposed measures and for being unclear and badly drafted.

Well-informed people connected with the beverage industry think that a diluted version of the directive will eventually emerge without too restrictive an effect on the industries concerned, nor causing distortion of trade among member states. Legislation is also often threatened in the European countries that would control packaging to prevent "waste."

The prime function of packaging is to enable consumers to receive products in good condition at the lowest reasonable price. Any manufacturer, distributor, or retailer concerned with design or use of packaging has a responsibility to ensure that there is a regular review of packaging having regard to the economics of the total manufacturing/distribution chain and to consideration of reuse and disposal. Marketing and commercial considerations should be reconciled as far as possible with economy in the use of materials and energy and the environment.

1. Packaging must comply with all legal requirements.
2. In containing a product the package must be designed to use materials as economically as practicable, while at the same time having due regard to protection, preservation, and the presentation of the product.
3. Packaging must adequately protect the contents under the normal foreseeable conditions of distribution and retailing and also in the home.
4. The package must be constructed of materials that have no adverse effects on the contents.
5. The package must not contain any unnecessary void volume nor mislead as to the amount, character, or nature of the product it contains.
6. The package should be convenient for the consumer to handle and use. Opening (and reclosure where required) should either be obvious or indicated and convenient and appropriate for the particular product and its use.
7. All relevant information about the product should be presented concisely and clearly on the package.
8. The package should be designed with due regard to its possible effect on the environment, its ultimate disposal, and to possible recycling and reuse where appropriate.

Figure 5. UK Code for the Packaging of Consumer Goods

Excessive packaging. The principle criticism is probably the accusation that "packaging is excessive." These accusations are usually made where the selling and convenience factors are concerned. It must be remembered, however, that the decision by the manufacturer of a product to put conveneience or selling into his packaging results from the decision that this will provide an advantage over a rival product produced by a competitive company. Most manufacturers are very concerned to keep their packaging costs to a minimum, and the objective of any convenience or sales appeal in the packaging must be better sales for the product.

Moreover, the social implications of excessive packaging may be measured against a code for good retail packaging first suggested by the Japanese Packaging Institute. A code of practice along the lines of the Japanese suggestion has been produced by the United Kingdom Packaging Council (see Fig. 5), responsible for considering complaints referred to it by any interested parties who feel that a particular package breaks the guidelines set out in the Consumer Goods Packaging Code.

Industry on both sides, user and maker, in the UK and many parts of Europe would favor the self-regulating approach suggested here, rather than legislation, and any proposals for regulations in this field will be resisted. The Japanese and UK codes are working reasonably well, although a second tier of the codes, detailing the means for determining compliance is needed.

BIBLIOGRAPHY

1. D. M. Conning, *International Symposium on Food Toxicology—Real or Imaginary Problems*, University of Surrey, July 1983, British Industrial Biological Research Association (BIBRA), UK.
2. P. S. Elias in Ref. 1.
3. L. Golberg in Ref. 1.
4. L. L. Katan in Ref. 1
5. A. Turner, "Labelling Legislation," *Symposium on Trends in Food Legislation*, Nov. 14–16, 1983 Hyatt Regency Hotel, Chicago, Leatherhead Food RA, UK and Grocery Manufacturers of America, Inc.

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LIDDING

Lidding is a very specialized aspect of flexible-packaging technology. The advent of portion packaging and dispensing packages created a need for flexible-packaging lidding materials, and liddings are frequently used to seal other types of packages, including semirigid containers. Lidding materials are rarely composed of just one layer. One or more layers provide physical properties, and other layers provide sealability. Generally, the ideal lid is one that is easily peelable, leaves no traces of sealant residue, and is tamper-evident (see Tamper-evident packaging). The sealant should melt at a relatively low temperature unless heat resistance is necessary for sterilization of the contents or reheating of a food product. Typical examples of lidding applications are shown in Figure 1.

The first considerations in the choice of a lidding must be

the intended use. Some of the questions that should be asked follow:

Must the lid prevent contamination or aid in dispensing the product by being peelable or having push-through properties?

What are the requirements for gas, moisture-barrier and light protection?

Should the lid be fusion-sealed or peelable?

What temperature resistance is required of the lidding? Is the product to be packaged hot? Will retained heat be a problem?

Should the lidding be heat-sealable or pressure-sensitive? Will the use of cold-seal adhesives be advantageous?

Figure 1. Typical examples of liddings used in packaging applications. A, Transparent lidding sealed to opaque preformed cupcake tray; because of rapid turnover, this type of product requires only the minimal barrier properties of a peelable lidding. B, Peelable lidding sealed to a vinyl-coated aluminum cup for liquid unit-dose drug applications; this type of lidding should be easily peelable, but also requires tamper evidence. C, Snack package utilizing a flexible, peelable lidding with good gas- and moisture-barrier properties. D, Peelable cheese lidding with good gas- and moisture-barrier properties. E, Sample package of shampoo utilizing a flexible lidding sealed to a tray formed from polyethylene-coated PVC sheet; this is an example of a fusion seal. F, Lidding for a PVC preformed tray containing sutures packed in alcohol.

Should the lidding be tamper-resistant?

What type of container will the lidding cover, and hov it be sealed to the container?

Will the lidding be left on during a temperature cycle sterilization)?

Must it also be resistant to electron-beam or nuclear st zation? If a lidding is used on a "cook-in-tray," will it b on during heating in a microwave or conventional o Liddings for cook-in-trays must also have good adhesi the tray while the product is in a refrigerated or fr state.

If the lidding is for an industrial application, it migh very easy to find an appropriate material. A typical exan would be a polyethylene-lined cannister filled with lubrica oil. An excellent lidding would be nylon/LLDPE (see Poly ylene, low density). However, if the application is for a f product, the parameters of the barrier properties, compati ity of food and container, storage conditions, and when how the lid is to be removed must be evaluated. Meeting ap cable FDA regulations is another important considerati With medical products, the problems of contamination of packaged item also have to be very carefully considered.

How a lid is removed is of prime importance on many pa ages. A tab, or something to hold onto, is highly desirat Ideally, the lid should peel off in one piece. A residue of seal should be avoided if possible, but sometimes the peelability the lid is designed to come about by separating the coati from the base stock. Examples of good bases for lidding stoc are paper/polymer/foil (see Multilayer flexible packaging) oriented polyester film (OPET), which also might have a b rier coating for improved protection.

In a paper/polymer/foil base stock, the polymer is genera polyethylene, but it can also be an ionomer (see Ionomers) ethylene–acrylic acid (EAA) to meet specific requirements. ionomer might be used to improve toughness or tear res tance. The next consideration is the protection of that side the foil that will face the container from the product bei packaged. If the product is inert to foil, protection is not nece sary, but because few products are chemically neutral, a ba rier layer next to the foil is generally essential. This can be simple as a vinyl coating, a vinyl film, a polyolefin film, or polyester film, depending on the product being packaged ar the type of protection needed. The heat-seal material is the applied over the protective layer (see Sealing, heat).

One of the simplest overwraps is nothing more than a co rona-treated (see Surface modification) OPET film (see Filn oriented polyester). Polyester film is normally not heat-sea able, but corona treatment changes the surface so that it ca be heat-sealed to itself. The seal must occur at a temperatur near the polymer's melting point with high seal pressures. Th seal is a fusion-type seal, but it is brittle and tears open easily The chief use of this type of material is to overwrap schoo lunch trays or sandwiches. The physical protection is minimal but it does act as a cover to prevent direct contamination Another use is as a wrapper around frozen pizza. It is one o the most inexpensive liddings that can be sealed to a polyester coated tray, but it is normally not used in "ovenable" applica tions.

Another important group of materials for tray liddings is

OPET film coated with ethylene–vinyl acetate (EVA) applied from a solvent system or as an extrusion coating (see Extrusion coating). Normally, lower coating weights can be applied from a solvent system. The coating makes the material not just sealable to itself, but to a variety of other materials. It also seals at relatively low temperatures. EVA coatings do not form fusion seals, but the seals are peelable and usually removable in one piece. This type of lidding is very popular for polystyrene sandwich trays or other food trays. Tray packs of cheese and luncheon meat often use a PVDC-coated OPET film with an EVA coating.

Ovenable liddings are usually solvent-based polyester coatings applied to a polyester base film. The coating is used to provide heat sealability, and by proper selection of polyester resins used in the coating formulation, different seal ranges can be obtained and the degree of peelability regulated. Another route to obtaining peelability is to incorporate inert fillers into a coating which normally makes fusion seals. Polyester coatings, in addition to sealing to polyester materials, usually also seal to vinyl materials. For example, a polyester-coated OPET lid seals very well to a semirigid PVC blister.

PVC (see Poly(vinyl chloride)) films and solvent coatings are used as sealants on liddings where fusion seals to PVC semirigid stocks are required. The coating can be modified to provide peelability. Liddings for orange-juice portion packs have traditionally been aluminum foil with vinyl-type coatings which seal to a vinyl cup. The vinyl coating is inert to the acidic juice and is also good film-former to protect the foil from corrosion. Newer-type liddings are foil/film laminations (see Laminating machinery) coated with a peelable heat-sealed coating. Similar liddings are used for yogurt, but they also require good barrier properties to extend the shelf life of the product.

Medicinal products in pill form are sometimes packed in PVC trays with a push-through-type lidding for ease in dispensing (see Pharmaceutical packaging). The tray is designed with wide flanges around each pill so that every pill is fusion-sealed in its own compartment and kept free of contamination. The lidding is usually a vinyl-coated aluminum foil, at least 0.001 in. (25.4 μm) thick for good barrier properties, which is sealed to a tray formed from semirigid PVC. The other popular pill package is the strip package. The strip package generally incorporates a peelable lidding having several plies. The outer layer is usually paper (to provide a good printing surface) which is then mounted to foil either by extrusion coating or adhesive lamination. The sealant side of the lidding can be a film or coating or a combination. The actual construction depends on the barrier requirements. If an extremely good barrier is necessary for very long shelf life, the structure can contain Aclar (Allied Corp.), which has exceptional barrier properties (see Film, fluoropolymer).

Other medical uses for liddings are safety seals on bottles to prevent tampering. These are combinations of materials that form fusion seals and are destroyed, ie, delaminated, when opened so that resealing is difficult. A safety seal is often fabricated with aluminum foil and mounted to a bottle-cap liner stock (see Closure liners) with wax. The combination of safety seal and cap liner is die-cut and placed in the bottle cap.The filled and capped bottle is passed through an induction sealer that fuses the safety seal to the bottle and melts the wax adhesive layer so the two parts separate when the bottle is opened.

For medical devices (see Health-care packaging) that are to be ethylene oxide (ETO) sterilized, a popular packaging technique is to use a PVC tray with a Tyvek-coated lid. Tyvek (DuPont) medical-grade materials are porous to ETO gas, but not to bacteria. The sealant requires only limited heat resistance, but the web must be porous to allow the ETO to penetrate the Tyvek. Tyvek can be coated with a sealant in a pattern that does not change the pororsity of the lidding. Another variation is to use a coating that is heat-sealable but not fused in drying so that it does not form a continuous film and therefore maintains porosity. Yet another option is to put the sealant material on the forming web so the Tyvek does not have to be coated.

Aluminum foil is normally used in a lidding if excellent barrier properties and protection from light are required. If the package is to be microwave-heated or requires transparency, foil is normally replaced with a PVDC-coated film which also gives very good barrier properties. Sealing methods are usually conductive-type heat seals. Important exceptions to this are safety seals in conjunction with a bottle-cap liner which use induction-type sealing equipment.

Further refinements of lidding technology can be expected as part of the current focus on semirigid replacements for metal cans (see Retortable flexible and semirigid packages).

BIBLIOGRAPHY

General References

C. J. Benning, *Plastic Films For Packaging*, Technomic Publishing Co., Inc., Lancaster, Pa., 1983.

R. C. Griffin, Jr., S. Sacharow, and A. L. Brody, *Principles of Package Development*, 2nd ed., AVI Publishing Co., Inc., Westport, Conn., 1985.

R. C. Griffin, Jr. and S. Sacharow, *Food Packaging*, AVI Publishing Co., Inc., Westport, Conn., 1981.

A. R. Endress, "Heat-Seal Coatings—Water and Solvent Based For Paper, Foil and Film," *Paper Synthetics Conference, Atlanta, Ga., Sept. 27–29, 1976*, TAPPI, Atlanta, Ga., 1976, pp. 55–57.

A. R. Endress, "Water Base and High Solids Coatings For Complying With E.P.A. Regulations," *Paper Synthetics Conference, Cincinnati, Ohio, Sept. 15–17, 1980*, TAPPI, Atlanta, Ga., 1980, pp. 205–207.

R. B. Schultz, "Heat Seal Coatings For Disposable Medical Device Packaging," *Paper Synthetics Conference, Atlanta, Ga., Sept. 13–15, 1982*, TAPPI, Atlanta, Ga., 1982, pp. 13–15.

F. R. Solenberger, "Health Care Packaging With Ionomers and EVA," *Paper Synthetics Conference, Atlanta, Ga., Sept. 13–15, 1982*, TAPPI, Atlanta, Ga., 1982, pp. 65–69.

R. Pilchik, "Lidding Materials for Formed-Filled-Sealed Packages of Medical Devices," *Paper Synthetics Conference, Lake Buena Vista, Fla., Sept. 26–28*, 1983, TAPPI, Atlanta, Ga., 1983, (1), pp. 221–224.

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LITERATURE. See Networks.

LITHOGRAPHY. See Printing.

gories: single-resin, unbalanced, and balanced films. Many films that are based on the performance properties of a single resin are coextruded for performance or cost reasons. Unbalanced structures typically combine a functional layer with a heat-seal resin. Balanced structures generally have the same heat-sealable resin on both sides of the film.

Single-resin structures. Single-resin films are coextruded for a variety of reasons. Many commodity film applications may not appear to be multilayer films, yet they actually have three or more distinct layers. Bakery, produce, and trash-bag films, for example, are often three-layer structures. The core material may contain pigment or recycled material, while virgin skin layers control surface quality and machinability. Single-resin coextrusions can also provide a differential coefficient of friction on the two surfaces.

Unbalanced structures. Typical of the unbalanced structures are films designed for vertical form/fill applications with a fin seal. A base resin such as high density polyethylene is augmented by an ethylene–vinyl acetate skin layer for sealability. For horizontal wrappers a polypropylene skin layer is sometimes selected for its higher thermal resistance. In another important unbalanced application, cast polypropylene, which has a limited sealing range, is combined with more sealable polyethylene for single-slice cheese wrappers (see Film, cast polypropylene).

There are multilayer films using only one polymer (A/A/A), unbalanced coextruded films with two or more polymers (A/B/C), and balanced multilayer structures with two or more polymers (A/B/C/B/A).

Balanced structures. Balanced coextruded structures typically have a core resin selected for its functionality plus two skin layers which are heat sealable. Oriented polypropylene films, for example, are increasingly coextruded instead of coated to attain machinable surfaces (see Film, oriented polypropylene). Frozen-food films are typically constructed with an EVA skin layer for enhanced sealability. Heavy-wall bags are regularly coextruded with LLDPE cores for impact strength and LDPE skins to limit the film's elongation under load. Primal meats are packaged in PVDC shrink film with EVA skins for seal integrity.

Two main applications which appear to be shifting from monolayer films to coextrusions are overwrap and stretch wrap (see Wrapping machinery, stretch film). Horizontal overwrap machines typically use an MDPE film or an LDPE–HDPE blend. Coextrusions can provide comparable overwrap machinability at lower gauge. Stretch wrap is difficult to produce as a single-layer structure without blocking. By splitting stretch wrap into a multilayer structure, its LLDPE core can be provided with controlled tackiness on the surface layer.

Table 1. Typical Coextruded-Film Structures

Outside layer	Core layer	Inside layer	Remarks
LDPE	white LDPE + recycle	LDPE	virgin skin layers control surface quality
HDPE	HDPE + recycle	EVA	EVA provides rapid fin seal machinability
EVA	LLDPE + recycle	EVA	EVA increases lap seal cycle time
LDPE	LLDPE + recycle	LDPE	LDPE limits film's elongation under load
EMA	OPP	EMA	oriented polypropylene sealability poor without coextruded or coated skin layers

BIBLIOGRAPHY

1. T. Alfrey, E. F. Gurnee, and W. J. Schrenk, *Polym. Eng. Sci.* **9**, 400 (1969).

General References

Coextrusion Patents

U.S. Pat. 3,222,721 (Dec. 14, 1965), M. Reynolds, Jr. (to Anaconda).

U.S. Pat. 3,223,761 (Dec. 14, 1965), G. E. Raley (to Union Carbide Corp.).

U.S. Pat. 3,321,803 (May 30, 1967), H. O. Corbett (to USI).

U.S. Pat. 3,308,508 Mar. 14, 1967), W. J. Schrenk (to The Dow Chemical Co.).

U.S. Pat. 3,398,431 (Aug. 27, 1968), H. O. Corbett (to USI).

U.S. Pat. 3,320,636 (May 23, 1967), H. O. Corbett (to USI).

U.S. Pat. 3,400,190 (Dec. 3, 1968), H. J. Donald (to The Dow Chemical Co.).

U.S. Pat. 3,477,099 (Nov. 11, 1969), R. E. Lee and H. J. Donald (to The Dow Chemical Co.).

U.S. Pat. 3,479,425 (Dec. 18, 1969), L. E. Lefevre and P. Dreidt (to The Dow Chemical Co.).

U.S. Pat. 3,476,627 (Nov. 4, 1969), P. H. Squires (to E. I. du Pont de Nemours & Co., Inc.).

U.S. Pat. 3,448,183 (June 3, 1969), D. S. Chisholm (to the Dow Chemical Co.).

U.S. Pat. 3,440,686 (Apr. 29, 1969), H. O. Corbett (to USI).

U.S. Pat. 3,524,795 (Aug. 17, 1970), N. R. Peterson (to The Dow Chemical Co.).

U.S. Pat. 3,557,265 (Jan. 19, 1971), D. S. Chisholm and W. J. Shrenk (to The Dow Chemical Co.).

U.S. Pat. 3,583,032 (June 8, 1971), L. O. Stafford (to Beloit).

U.S. Pat. 3,365,750 (Jan. 30, 1968), H. J. Donald (to The Dow Chemical Co.).

U.S. Pat. 3,611,492 (Oct. 12, 1971). R. Scheibling (to Siamp-Cedap).

Die Design

R. J. Brown and J. W. Summers, *Plast. Eng.* **37** (9), 25 (Sept. 1981).

Melt Rheology

J. H. Southern and R. L. Bullman, *J. Appl. Polym. Sci.* **20**, 175 (1973).

J. D. Han, *J. Appl. Polym. Sci.* **17**, 1289 (1973).

A. E. Everage, *Trans. Soc. Rheol.* **17**, 629 (1973).

General Extrusion Processes

G. R. Moore and D. E. Kline, *Projection and Processing of Polymers for Engineering*, Prentice-Hall, New York, 1984

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COEXTRUSIONS FOR SEMIRIGID PACKAGING

This article pertains to flat semirigid coextruded sheet which is a minimum of 0.010-in. (0.25-mm) thick (see Coextru-

Table 1. Barrier Materials

Resin	O_2 Transmission rate[a]	Water-vapor[b] transmission rate	Mid-1985 price, \$/lb (\$/kg)
EVOH (Eval F, Kuraray)	0.035 [0.136]	3.8 [1.50]	2.41 [5.31]
PVDC (Saran 5253, Dow Chemical)	0.15 [0.583]	0.10 [0.04]	1.02 [2.25]

[a] $cm^3 \cdot mil/(100\ in.^2 \cdot d \cdot atm)$ $[cm^3 \cdot \mu m/(m^2 \cdot d \cdot kPa)]$ at 73°F (23°C), 75% rh.
[b] $g \cdot mil/(100\ in.^2 \cdot d)$ $[g \cdot mm/(m^2 \cdot d)]$ at 100°F (38°C), 90% rh.

sion machinery, flat). These coextruded sheet structures are thermoformed to produce high barrier plastic packages (see Barrier polymers; Thermoforming). A similar concept is used to produce high barrier plastic bottles except that the bottles are formed from coextruded multilayer tubes instead of flat sheet (see Blow molding).

The production of coextrusions for semirigid packaging was made possible by technology developed in the late 1960s and early 1970s (1, 2). Utilization of this technology was initially limited to "simple" structures such as two-layer systems (a general purpose polystyrene cap layer on a high impact polystyrene base layer) for drink cups. Commercialization of high-barrier coextrusions occurred in the 1970s in Europe and Japan. Large-scale commercial barrier coextrusion applications did not surface in the United States until the 1980s. For purposes of this discussion, barrier materials are defined as those that exhibit an oxygen transmission rate of less than 0.2 $cm^3 \cdot mil/(100\ in^2 \cdot day \cdot atm)$ $[0.777\ cm^3 \cdot \mu m/(m^2 \cdot d \cdot kPa)]$ (see Barrier polymers). Other techniques that can be used to produce multilayer barrier structures are coating and lamination (see Coating equipment; Laminating). Some advantages coextrusion offers versus these other two methods are thicker barrier layer capability, single-pass production, barrier layer sandwiched between cap layers, and generally lower cost. The potential markets for packages formed from these high-barrier coextrusions include both low- and high-acid food products sterilized by aseptic, hot-fill, or retort methods. These markets obviously represent a significant opportunity for barrier coextrusions.

Barrier Materials

Based on the barrier definition above, only two commercially available thermoplastic resins can be considered as barrier resin candidates for these extrusions. These are ethylene–vinyl alcohol (EVOH) (see Ethylene–vinyl alcohol) and poly(vinylidene chloride) (PVDC) (see Vinylidene chloride copolymers). The barrier properties of specific grades of these two materials are listed in Table 1. The resins identified in the table are currently the highest barrier commercially available coextrudable resins of their respective polymer classes. Other formulations of both resin types are available offering certain property and processing improvements at the sacrifice of barrier properties.

The most significant technical issue concerning the use of EVOH as a barrier material is its moisture sensitivity. The material is hygroscopic, and its barrier properties are reduced as it absorbs moisture. The importance of this property to the food packager is dependent upon the sterilization process, food type packaged, and the package storage conditions. The most severe conditions are encountered during retort processing (see Canning, food). Special consideration to coextrusion structure design and post-retorting conditions may be required to achieve the desired oxygen barrier for packages produced from EVOH coextrusions (3).

PVDC is not moisture sensitive and does not exhibit the deterioration of barrier properties shown by EVOH. The challenges associated with using heat-sensitive PVDC are faced by the coextruded sheet producer. Equipment and process design are critical to the production of coextrusions containing PVDC. Concern relating to the reuse of scrap generated in the production of coextrusions based on PVDC is a real economic issue. Development of new material forms and recycle-containing structures is underway with commercialization targeted for 1985 (4). In the meantime, resin manufacturers are working on the development of other types of barrier materials for coextrusion applications (5).

Structural Materials

The materials generally used to support the barrier resins in coextrusions are listed in Table 2. The maximum process temperature listed is the highest sterilization temperature that packages based on these resins should experience. Polystyrene, polypropylene, and the polyethylenes are the predominant structural materials used in coextrusions for semirigid

Table 2. Structural Materials

Resin	Maximum process temperature, °F (°C)	Mid-1985 price \$/lb (\$/kg)
polystyrene	195 (90.6)	0.49–0.51 (1.08–1.12)
polypropylene	260 (127)	0.43–0.47 (0.95–1.04)
high density polyethylene	230 (110)	0.44–0.50 (0.97–1.10)
low density polyethylene	170 (77)	0.40–0.44 (0.88–0.97
polyester, thermoplastic (heat-set)	>260 (>127)	0.63–0.67 (1.39–1.48)
polycarbonate	>260 (>127)	1.69–1.81 (3.73–3.99)

packaging applications. Structural resin selection is dependent upon use requirements, coextrusion processability, and container-forming considerations.

Polystyrene (see Polystyrene) exhibits excellent coextrudability and thermoformability. It can be used in applications requiring low temperature processing and in some hot-fill applications. Polypropylene (see Polypropylene) is also excellent from a coextrusion-processing standpoint, but it requires special forming considerations. Deep-draw containers from polypropylene-based sheet are most commonly formed using solid-phase forming techniques. Polypropylene can be retorted; but some grades exhibit poor low temperature impact characteristics which limit their use in applications requiring resistance to refrigerated or freezing temperatures.

High density polyethylene (see Polyethylene, high density) offers a significant improvement in low temperature properties compared to polypropylene, but its suitability in applications requiring retort processing is marginal. Low density polyethylene would be incorporated in coextrusions requiring good heat sealability (see Sealing, heat) for applications involving low-temperature-fill conditions.

Although coextrusions based on crystallizable polyester (see Polyesters, thermoplastic) and polycarbonate (see Polycarbonate) are not commercially available at this time, these materials are included as structural materials because of their future potential in retort applications. The success of these relatively expensive materials will be dependent on the cost and performance achieved. Considerable developments of coextrusion and forming techniques need to be completed prior to commercialization of coextrusions based on polyester and/or polycarbonate.

Applications

Three representative commercially coextruded structures are shown in Table 3. The transition layers in these structures are materials used to ensure the integrity of the coextrusion. The technology of transition layers is complex and maintained as proprietary by coextrusion manufacturers. The first structure, which uses polystyrene as both cap layers, finds use in form/fill/seal applications because of the particularly good thermoformability of polystyrene (6) (see Thermoform/fill/seal). The second structure has one polystyrene cap layer to maintain thermoformability and one polyolefin cap layer. The polyolefin layer in this case would be the food-contact layer. This structure would comply with the current FDA regulations for aseptic H_2O_2 package sterilization (see Aseptic packaging). The resins that comply with current FDA regulations for H_2O_2 sterilization are polyethylenes, polypropylenes, polyesters, ionomers (see Ionomers), and ethylene vinyl acetates (EVA). Petitions have been submitted for FDA clearance of polystyrene and ethyl methyl acrylate (EMA) as food-contact layers as well. Containers formed from this structure, with polypropylene as the food-contact surface, can also be hot filled (7).

The last structure shown in Table 3 has the most potential of those listed because it can be used in applications including retort processing. The primary market target for coextrusions with polypropylene as the cap layers is processed foods currently in metal cans (8, 9).

In addition to the food-packaging markets, barrier coextrusions can be utilized in the medical (see Health care packaging), pharmaceutical (see Pharmaceutical packaging), and industrial packaging markets where barriers to oxygen, moisture, and hydrocarbons are required.

Table 3. Commercial Coextrusions

Structure	Application
polystyrene transition barrier transition polystyrene	form/fill/seal preformed containers hot fill
polystyrene transition barrier transition polyolefin	form/fill/seal preformed containers H_2O_2 aseptic hot fill
polypropylene transition barrier transition polypropylene	preformed containers H_2O_2 aseptic hot fill retort

Economics

Simply utilizing resin prices to calculate a material cost for a coextruded sheet structure can be unreliable in determining the economics of barrier plastic packages. Using material prices only to compare the economics of several coextruded sheet structures based on different resins can result in erroneous conclusions. Items such as required equipment costs, coextrusion output rates, package-forming method and rates, amount of scrap generated, amount of scrap reutilized, container design, and container performance are some of the cost considerations that can be dissimilar for different coextruded sheet structures. Economic comparison of various coextruded barrier packages with alternative packaging materials should be based on a total packaging systems analysis. The current commercial applications and market tests underway show that packages from coextruded sheet offer economic and/or performance advantages versus other packaging materials.

BIBLIOGRAPHY

1. U. S. Pat. 3,479,425 (Nov. 18, 1969), L. E. Lefeure and P. Braidt (to Dow Chemical Company).
2. U. S. Pat. 3,557,265 (Jan. 19, 1971), D. Chisholm and W. J. Schrenk (to Dow Chemical Company).
3. K. Ikari, "Oxygen Barrier Properties and Applications of Kuraray EVAL Resins," presented at Coex 1982, sponsored by Schotland Business Research, Inc., Princeton, N. J.
4. W. J. Schrenk and S. A. Marcus, "New Developments in Coextruded High Barrier Plastic Food Packaging," presented at SPE–RETEC, Cleveland, Ohio, April 4–5, 1984.

Table 4.8 Advantages and disadvantages of horizontal f.f.s. pillow and sachet packs (adapted from material presented by A. P. Benson, Institute of Packaging Education Course, February 1980)

Advantages	*Disadvantages*
Pillow pack	
Good product volume/pack size ratio. Very wide range of materials from inexpensive coated films and papers to complex laminates. Relatively simple machine construction and comparative low cost of packaging machinery. Easy adjustability for a wide range of sizes. Smooth continuous motion action, giving options ranging from high output (600 ppm lines) to low output (40 ppm lines) high versatile units.	Unsuitable for powders or granular products. Limited size range versus conventional overwrapping machines.
Sachet pack	
Short product drop (compared to vertical sachet machines) means reduced filling time and high line speeds (up to 400 ppm). Pack forming and sealing is performed away from the filling station(s) so that sealing efficiency is not impaired by product trapped between the seals. Pack rigidity superior to pouch-style pack. High degree of seal efficiency from four-sided fin-seal system. Automatic filling of multiple product loads is possible.	Product volume/pack size ratio is not as good as on pillow pouch machines. Inexpensive, "unsupported" wrapping materials cannot generally be used, since the operating principle demands the use of more rigid, laminated materials. Packaging machinery tends to be significantly more expensive than pillow pouch packaging machinery.

web over the open tray so as just to cover the flanges of the trays to permit a heat seal closure (figure 4.46). The web of filled and closed packages is then punched out to form individual packages, or may be slit at intervals to give a number of units joined together. Such machines operate at speeds of from 6 to 20 cycles per minute, and the number of packages produced will depend on the number formed per cycle which in turn is generally dependent on the area they occupy.

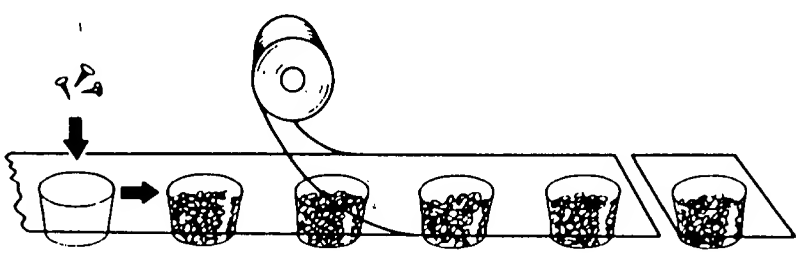

Figure 4.46 Thermoformed f.f.s. packs.

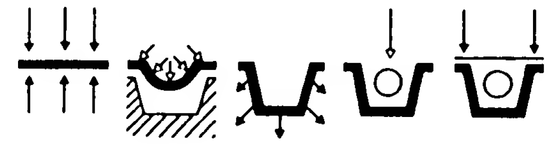

Figure 4.47 The steps in making thermoforms. (*a*) Heating; (*b*) forming; (*c*) cooling; (*d*) filling; (*e*) sealing.

Figure 4.47 illustrates the steps in the packaging operation. Heating, forming, cooling and sealing are the most important steps in producing the thermoformed (deep-drawn) package. Thermoforming the film is especially important. Figure 4.48 contains a summary of the possible forming methods, of which the most commonly used are negative vacuum forming, with or without plug assist and negative compressed air forming, with or without plug assist. In these methods, the heated film is formed in a mould (negative forming). In vacuum forming, the force is provided by the difference in pressure between the evacuated mould and the atmosphere of 1 bar (1 kg/sq. cm). In compressed air forming, forming pressures of 6 8 bars are common.

Vacuum forming results in irregular wall thicknesses in a deep-drawn cavity (figure 4.49). The most uniform wall thickness distribution is produced by means of compressed air forming with plug assist. Compressed air forming without plug assist also results in more uniform wall thicknesses than with vacuum forming. However, the machinery required for this method is more complicated—and more expensive—than comparable machines for vacuum forming.

The requirements for processing laminated films (PVC-PVDC, PVC-PFC, PVC-PE-PVDC), and for producing more complicated shapes, are basically different. As a result of the required high forming force in the partially limited forming temperature range, only the compressed air forming method, either with or without plug assist, can be employed. Mechanical pre-stretching is always required for complicated shapes. Compressed air forming alone does not provide uniform distribution of the material in the deep-drawn cavity. There are six main materials used for thermoforming.

(i) *Rigid PVC film (polyvinyl chloride)*. This is produced primarily by calendering. It has good thermoforming properties, and is generally processed clear, coloured and printed. It can be sealed by HF, ultrasonic, radiation, heat impulse and heat contact methods.

(ii) *Polystyrene film*. This is produced almost exclusively by extrusion. It has good thermoforming properties, similar to rigid PVC film. Clear, stretched

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vide a package with a valve system that will allow a product such as coffee to outgas without causing the package to rupture or balloon (see Vacuum coffee packaging).

Hesser also makes a system that produces a container similar to a composite can. This machine takes a laminate from rollstock and forms a rectangular body. It then attaches one end, fills the container and seals a lid to it. This equipment has the capability to make an aseptic package.

Horizontal form/fill/seal is an extremely dynamic segment of the packaging industry, for materials and equipment are continually improving, presenting new opportunities. New coextruded structures offer barrier and machining possibilities that are expanding the range of food products that can be packaged in flexible film (see Coextrusions for flexible packaging; Coextrusions for semirigid packaging). Aseptic packaging is another growth area that will add new dimensions to food packaging. In conjunction with the advance in these technologies are equipment developments that will provide a basis for expansion and cost reduction.

General References

Packaging Encyclopedia and Yearbook 1985, Cahners Publishing.

PMMI Packaging Machinery Directory, Annual, Packaging Machinery Manufacturers Institute, Washington, D.C.

J. H. Briston, L. L. Katan, and G. Godwin, *Plastics Films*, Longman, New York, 1983.

F. A. Paine and H. Y. Paine, *A Handbook of Food Packaging*, Blackie and Son Ltd., Glasgow, 1983.

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FORM/FILL/SEAL, VERTICAL

The term form/fill/seal means producing a bag or pouch from a flexible packaging material, inserting a measured amount of product, and closing the bag top. Two distinct principles are utilized for form/fill/seal packaging; horizontal (HFFS) (see Form/fill/seal, horizontal) and vertical (VFFS). Generally, the type of product dictates which machine category applies. This article deals specifically with VFFS equipment, which forms and fills vertically. It is used to produce single-service pouches for condiments, sugar, etc, as well as bags for retail sale and institutional use. The range of products and sizes is very large.

Package Styles

VFFS machines can make a number of different bag styles (see Fig. 1):

A pillow-style bag with conventional seals on the top and bottom, and a long (vertical) seal in the center of the back panel from top to bottom. The long seal can be a fin seal or a lap seal (see Fig. 1 a and b)

A gusseted bag with tucks on both sides to make more space for more product and maintain the generally rectangular shape of the filled bag (see Fig. 1 c). This style is used inside folding cartons for cereal and other dry products (see Bag-in-box, dry product)

A three- or four-sided seal package is similar to those made on HFFS machinery (see Fig. 1 d).

A stand-up bag (flat bottom, gabletop) of the type that used to be common for packaging coffee.

Other special designs such as tetrahedrons, parallelograms, and chubs (see Chub packages).

A flat-bottom bag needs a relatively stiff material to hold its desired shape, but any type of machinable material can be used to make a pillow-style bag. Various options are available, such as a hole punch for peg-board display, header labels which are an extension of a standard top of a bag, carry-handles for large consumer-type packages, and special sealing tools for hermetic seal integrity.

Materials

Two types of packaging materials are suitable for VFFS: thermoplastic and "heat-sealable" materials. Polyethylenes (thermoplastics) require a special bag-sealing technique. Polyethylene films must be melted under controlled conditions until the areas to be attached to each other are fused. The operation is analogous to welding metals. Heat is applied to fuse the materials and then a cooling process allows the seal to set. The sequence for making good seals requires careful control in order to get quality-seal integrity. Impulse sealing is used to seal thermoplastics on VFFS machines. A charge of electricity is put into a Nichrome wire which heats to a pre-established temperature (governed by material thickness) that will melt and fuse the materials. Since thermoplastics become sticky when melted, the Nichrome wire is covered by a Teflon (Du-Pont Company) sheath. The principle of impulse sealing does not require any specific tooling pressure.

Thermoplastic materials are generally used when a high degree of product protection is not required and low material cost is important. Polyethylene materials have some porosity and are not ideal for applications where hermetic seals are

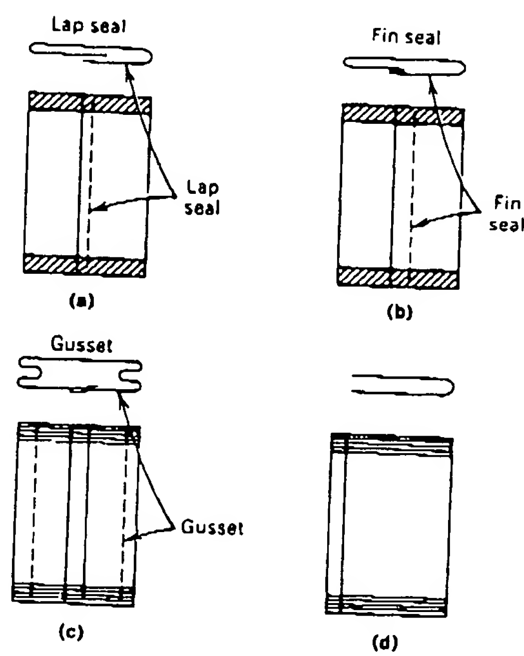

Figure 1. Selected package styles on VFFS machinery. (a) and (b), Pillow style; (c), gusseted style; (d) three-sided seal.

necessary for good shelf life, product freshness, gas flushing, etc. They are used, for example, for frozen foods, chemicals, confectionary items, fertilizers, and peat moss.

The class of "heat-sealable" materials or "resistance seal films" includes paper and cellophane as well as some coextrusions and laminations. Because these materials do not melt at sealing temperatures, or do not melt at all, they require a heat-seal layer that provides a seal with the right combination of time, temperature, and pressure. The sealant layer can be on one or two sides of the web, depending on the desired package configuration (see Multilayer flexible packaging).

A fin seal (see Fig. 1) can be made of materials with sealing properties on one side only, because the "heat-scalable" surface seals to itself. This seal is effective for powder products that need the seal to eliminate sifting. It is also a good seal if hermetic-seal integrity is important, as in gas-flush packaging. A lap seal uses slightly less material, but it requires sealing properties on both sides because the lap is made by sealing the inner ply of one edge to the outer ply of the other edge.

Machine Operation

A VFFS machine produces a flexible bag from flat roll stock. Material from a roll of a given web dimension is fed through a series of rollers to a bag-forming collar/tube, where the finished bag is formed (see Fig. 2). The roller arrangement maintains minimum tension and controls the material as it passes through the machine, preventing overfeed or whipping action. The higher the linear speed of the film, the more critical this handling capability becomes.

The bag-forming collar is a precision-engineered component that receives the film web from the rollers and changes the film travel from a flat plane and shapes it around a bag-forming tube. The design of the bag-forming collar can be engineered to get the optimum efficiency from metallized materials, heavy paper laminates, etc. As the wrapping material moves down around the forming tube, the film is overlapped for either the fin or lap seal. At this point, with the material wrapped around the tube, the actual sealing functions start. The overlapped material moving down (vertically) along the bag-forming tube will be sealed. The packaging material/film advances a predetermined distance that equals the desired bag-length dimension. The bag length is the extent of the material hanging down from the bottom of the tube. The bag width is equal to ½ of the outside circumference dimension of the tube. After the film advance is completed, the bag-sealing and -filling completes the remainder of one cycle (film advance/fill/seal). There are two sets of tooling on the front of the machine. One of the sealing tools, the vertical (longitudinal or back) seal bar, is mounted adjacent to the face of the forming tube. Its function is to seal the fin- or lap-longitudinal seal which makes the package material into a tube.

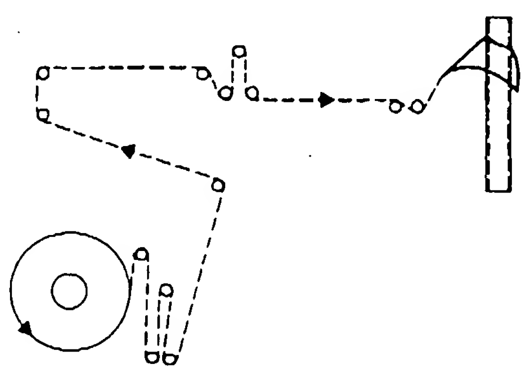

Figure 2. Typical film feed path through a vertical form/fill/seal machine.

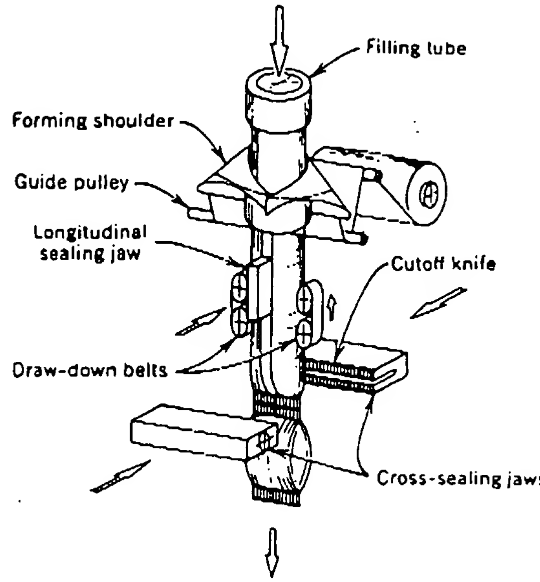

Figure 3. Typical VFFS configuration.

The other set of tooling, the cross (end) seal, consists of a front and rear cross-sealing jaw that combines top- and bottom-sealing sections with a bag cutoff device in between. The top-sealing portion seals the bottom of an empty bag suspended down from the tube, and the bottom portion seals the top of a filled bag. The cutoff device, which can be a knife or a hot wire, operates during the jaw closing/sealing operation. This means that when the jaws open, the filled bag is released from the machine. All vertical bag machines utilize this principle to make a bag (see Fig. 3).

Machine Variations

Film transport. Two distinct machine designs are used for transporting the packaging material/film through the machine. The traditional design clamps the material with the cross-seal jaws and advances the material by moving the cross-seal jaws down. This is called a "draw bar" (reciprocating up-down cross-seal jaws). The other is a drive-belt principle for film advance, which leaves the cross-seal bars in a fixed horizontal position with only open-close motion. The belt-drive film-advance principle has been shown to be the most versatile design for high speed packaging and simplicity of operation, and a number of companies have converted to this principle.

Power. There are several approaches to providing power for material/film transport and the filling and sealing operations: all electromechanical; electromechanical/pneumatic; and electromechanical/pneumatic/vacuum.

The electromechanical vertical-bag machine incorporates a cam shaft with a series of cams to operate the various functions. The package material/film drive motion works off a mo-

E. Marston Associates
603/890-6587

Del Monte

Del Monte Fresh Produce N.A., Inc.

To: Manny Zantua

Date: ~~January 4,~~ 1999

From: Denise Cavanaugh

cc: Dan Funk

Subject: Banana packing trials

As you are well aware, on 12/9 we re-packed bananas here at Manatee with 4 different treatments. These bananas were held for two weeks. On 12/21 the gas analysis were taken and sent to Dr. E.V. Marston for measurements. The treatments were then sent to Plant City for processing. On 12/28, I retrieved one sample of each treatment for quality evaluation. The results are as follows:

Treatment 1 Banavac 1.5 mil LLDPE was ripped before gassing, and upon arrival here at the port were a uniform stage 6. 6

Treatment 2 Banavac 0.8 mil HDPE was ripped before gassing and the results were also a uniform stage 6. 6

Treatment 2 Banavac 0.8 mil HDPE which were not ripped before gassing was a 1 ½ upon arrival here at the port. As of today, after being held at ambient temperature for 6 days, they are a uniform stage 4 ½. 1½

Treatment 3 Type C184 Test Bag which were not ripped before gassing, were a uniform stage 5 ½. 5½

Treatment 4 Type A168 Test Bag which also were not ripped before gassing, were a uniform stage 4. 4

If there are any other questions, please contact me.

Thanks and best regards

Dr. Marston:
I'm somewhat surprised by overall results. I'll try to send you a short letter before I start a 1-month travel period Friday. DJ

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Serial No. 09 528,290,
Atty. Dkt. No. MARS93

LETTER 1

DEL MONTE FRESH PRODUCE COMPANY
P.O. BOX 149222 - CORAL GABLES, FL 33114-9222
R&D/QA DEPARTMENT FACSIMILE TRANSMISSION
FAX (305) 445-7612 - TELEPHONE (305) 520-8089

TO: Dr. Elizabeth Marston
(603) 890-6735

DATE: January 12, 1999

FROM: D.W. Funk

cc: D. Cavanaugh
M. Zantua

NUMBER OF PAGES 1 (including cover)

SUBJECT: Banana Bag Trial at Port Manatee

Ripening trials carried out at our Plant City, FL, facility showed that ethylene penetrated both test bags to approximate standard ripening. And, as anticipated, banana ripening was delayed when the fruit was enclosed within intact standard Banavac bags. It is important to note that, at least in pressurized rooms, the fruit ripening was not accelerated by the test bags – which might have indicated interference with cooling.

The gas sampling analyses are of more interest to me. Literature suggests that the standard 1.5 mil PE Banavac bag maintains a modified atmosphere of approximately 2% oxygen/5% carbon dioxide. Your data show about 18% oxygen/2% carbon dioxide for these bags, pretty similar to data, which we had developed for melons. I'm now questioning the validity of information in the literature, and have asked Cryovac to talk with me about this situation.

Both test bags performed better than the banavac standards, but I don't know if the differences are of significance. And I'm at a loss to understand why perforated bags should maintain a higher level of carbon dioxide under these conditions. This trial has shown that I have to investigate CA/MA influences on fruit maturity more thoroughly.

Regards.

Dan

DWF1828: omr

PLEASE CALL (305) 520-8184 IF ANY PART OF THIS COMMUNICATION IS ILLEGIBLE OR INCOMPLETE.

May 1, 2001

To: Rob Rudman / BOSKOVICH FARMS
From: Steve Layton/SOCOPAC

Re: Iceless Green Onion Packaging Trials

1st Trial Summary:

Bunched iceless green onions were packed and stored for 29 days at BOSKOVICH FARMS, Oxnard in February of this year. Three modified atmosphere packages were tested, The EXTEND™ mechanically perfed liner bags and two laser perfed (Micro Cap™) liners. The test results are shown on the attached report dated 3/1/01 (please see disc).

The test results showed that all three liner specifications provided salable green onions after 15 days refrigerated (34 F°) storage with onions that had initially been shipped, top iced, from Mexico.

After 21 days, the mechanically perfed and "A" laser perfed bags began to dehydrate, slime and curve. The "B" laser perfed bags remained clean and salable. After 29 days the "B" laser perfed bags evidenced 5-10% stem decay while the "A" laser perfed bags and mechanically perfed bags were definitely unsalable.

It was decided to run a second storage trial with two additional laser perforation specifications, further fine tuning the specifications based on the initial test results.

2nd Trial Summary:

A second storage trial was run April 4 through May 1, again on Mexican, top iced bunched onions. Four cartons each were packed in laser perfed styles "C" and "D" liners (MICRO-CAP™) and 1 carton was packed in a mechanically perfed (MP) locally supplied liner. Onions were graded as having 5-10% physical damage when packed.

:rial No. 09/528,290,
tty. Dkt. No. MARS93

LETTER 3 (1/2)

Observations were made after 21 days (4/25) and again 28 days (5/1) at 34 F°. Louis Davilla was present during all the observations.

Results After 21 Days:

	Odor	Color	Texture	General
MICRO-CAP "C":	0	exclnt	crisp	salable no decay
MICRO-CAP "D":	0	exclnt	crisp	salable no decay
MP:	0	slight darkening	slight softening	salable, slight dehydration

Both Louis and I felt that the onions looked better when opened after 21 days then when packed. All were considered salable, with the onions packed in the "C" liner looking slightly sounder.

Results after 28 Days:

	Odor	Color	Texture	General
MICRO-CAP "C":	0	exclnt	sftning	salable 5% decay
MICRO-CAP "D":	0	exclnt	sftning	marginal, 15% decay
MP:	0	drkning	sftning	bulb slime, 20-25% stem decay, unsalable

The MICRO-CAP "C" liner was observed as the better liner after 28 days storage, producing a salable but slightly stressed appearance. This is thought to be due to the liners ability to micro-manage the internal atmosphere in the package. Mechanically perfed bags with physical holes, somewhat reduce dehydration however the holes are unable to specifically manage internal package atmosphere. It can be surmised from both tests that a month is the optimum storage time that can be expected from MICRO-CAP liners at the storage conditions noted with onions of the quality and condition packed in both tests.

Photos of the 28 day test results on the second trial are attached on disc. (jpg files)

Del Monte

I... / INTRA-COMPANY CORRESPON...CE

Del Monte Fresh Produce Company

TO: T. Young/J. A. Yock

DATE: Jul. 31, 2001

COPIES: J. P. Bartoli/C. Abarca
D. Murray/D. Marin
O. Pessoa/B. Medrana
G. Restrepo/R. Cariel
J. Clark/P. Franceri
J. Lopez/R. Paningbatan

FROM: Manny
M. I. Zantua

SUBJECT: **Micro-CAP™ Plastic Banana Bag Trials in Europe**

Highlights in this report are based on the following evaluations in Europe:

1. Cameroon banana evaluated in U.K. by John Clark 06/12/01.
2. Costa Rican banana evaluated in U.K. by John Clark 06/27/01.
3. Colombian banana evaluated in Antwerp by Ricardo Carriel 07/05/01.
4. Costa Rican banana evaluated in Italy by Paolo Franceri 07/19/01.

History. In 1999, post-harvested storage and ripening of banana in Port Manatee, Tampa were evaluated in two micro-perforated bags (Type C184, Type A168) and compared them to the regular 1.5 mil LLDPE Banavac bag. Micro-perforated bags allowed a build-up of carbon dioxide 4-6% (or reduction of oxygen to 17-16%, correspondingly), but only about 2% (18% oxygen) in the regular Banavac bag. After two-week storage, we were able to ripen the fruit normally without tearing the micro-perforated bags – implying that ethylene gas permeates through the micro-pores (fruit inside intact Banavac bag did not ripe). One week after ripening, fruit inside the Type A168 was uniform color 4 while the ripped Banavac bag was color 6 – indicating that color development is slower (or increasing ripe shelf life of banana) in the micro-perforated bag.

Crown rot/mold on Colombian fruit continued to be a problem in Germany. Aside from post-harvest fungicide, shipping banana in controlled or modified (Banavac) atmosphere reduces crown rot incidence. The objection of Banavac packaging in Germany is the extra cost and/or handling involved in ripping the bag just before gassing. The use of micro-perforated bag will resolved both the crown rot/mold and handling problem on Colombian fruit going to Europe. These trials were therefore established to evaluate the effects micro-perforated bags on crown rot and mold control and ripening of the fruit.

Summary of findings is as follows:

- Cameroon banana in U.K. ripened uniformly in Micro-CAP™ bag similar to that of ripped Banavac bag, but color is about ½ less in the former. Un-ripped banavac did not ripe. No problem reported on crown rot or mold in both bags.

- Costa Rican banana in U.K. ripened uniformly inside Micro-CAP™ and cut Banavac bags, but the former has more under color boxes supporting the slower color development. No problem reported on crown rot and mold in both bags. Un-ripped banavac did not ripe.

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y. Dkt. No. MARS93

LETTER 4 (1/2)

- Colombian banana in Belgium was ripened with a slow ripening process in a conventional ripening room. One week after gassing fruit inside Hydropack, Micro-CAP™ and Polypack color stages were between 3-5 in the different bags. Polypack and Hydropack fruit has some crown turning yellow, whereas, 100% of the crown in the Micro-CAP™ bag was full green. This is a very significant finding. Some crown mold was observed on the crown of clusters without post-harvest fungicide in the Hydopack bag.

- Costa Rican banana in Italy has color stage 3 after 5 days in Banavac bag but same color stage after 7 days in Micro-CAP™ bag. No problem reported on crown rot/mold in both bags.

In short, the initial data obtained in 1999 in Manatee are being confirmed by these different trials sent to Europe. Modified atmosphere packaging in either 1.5 mil LLDPE Banavac or Micro-CAP™ is helping in the control of crown rot/mold. The handling problem of Banavac in Germany can be resolved by using Micro-CAP™ bag.

Acknowledgement

The valuable help, support and preparation of the trials extended by the tropical operations (G. Restrepo, O. Pessoa, D. Marin, B. Medrana) and actual fruit evaluation in Europe (A. Abarca, J. Clark, R. Carriel, P. Franceri) are very much highly appreciated. Without them, it will be impossible to obtain this very significant information.

Del Monte

Del Monte Fresh Produce Company

August 1, 2001

Dr. E. V. Marston
EV Marston & Associates
18 Wilson Road
Windham, NH 03087

Dear Dr. Martson

Attached you will find the results of the Micro-CAP™ trials in Europe. Similar to our initial trial, the results are very positive. Can the micro-perforations be placed close to the bottom of the bag so they will be close to the shoulder or at the side of the box for complete and constant exposure?

In using the data presented in this report, we must request that the name "Del Monte" or "Del Monte Fresh Produce Company" not be used in the promotion and/or sale of your Micro-CAP™ plastic bag material.

Thank you very much for giving us again the opportunity to test your micro-perforated bag. We will continue further experimentation on the remaining bags that you have given us.

Sincerely,

M. I. Zantua

M. I. Zantua

Cc: Tom Cowan
PPC Industries, Inc.

:rial No. 09/528,290,
tty. Dkt. No. MARS93

LETTER 5

A 3# M. kon broccoli floret bag (2 mil PE ase film) with <u>microporous</u> patch as an example of the technology described in De Moor (Patent No. 6,013,293, Jan 11, 2000).

EXIBIT A
S/N 09/877,757

MARKON®

MARKON

READY·SET·SERVE®

Regular Cut

FOODSERVICE CAULIFLOWER FLORETS

NET WT 48 oz. (3 lbs.) 1.36 kg

Keep Refrigerated. For Maximum Yield, Best If Stored at 34°- 36° F (1°- 2° C).

READY·SET·SERVE™

Distributed By: Markon Cooperative, Inc. Salinas, CA 93901
Produce Of U.S.A. Shipping In Season From California & Arizona

Ⓚ

08

A 3# Markon broccoli floret bag (2 mil PE base film) made according to Patent Application No. 09/877,757) with microperforations (circled in black) placed in the upper quarter of the bag so they will not be occluded during case carton packing. Note that the customer (Markon) switched to the microperforated bag and is no longer using the microporous patch bag (i.e., the De Moor bag) for this product.

EXIBIT B
S/N 09/877,757

MARKON.

MARKON

READY·SET·SERVE®

Regular Cut

FOODSERVICE BROCCOLI FLORETS

NET WT 48 oz. (3 lbs.) 1.36 kg.

Keep Refrigerated. For Maximum Yield, Best If Stored at 34°- 36° F (1°- 2° C).

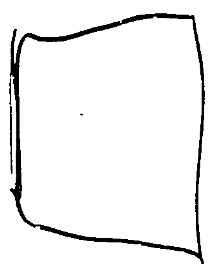
READY·SET·SERVE™

Distributed By: Markon Cooperative, Inc. Salinas, CA 93
Produce Of U.S.A. Shipping In Season From California & Arizo

Polyethylene coextruded rollstock microperforated according to Patent Application No. 09/877,757. The microperforations are registered directly across from the eye mark in each impression.

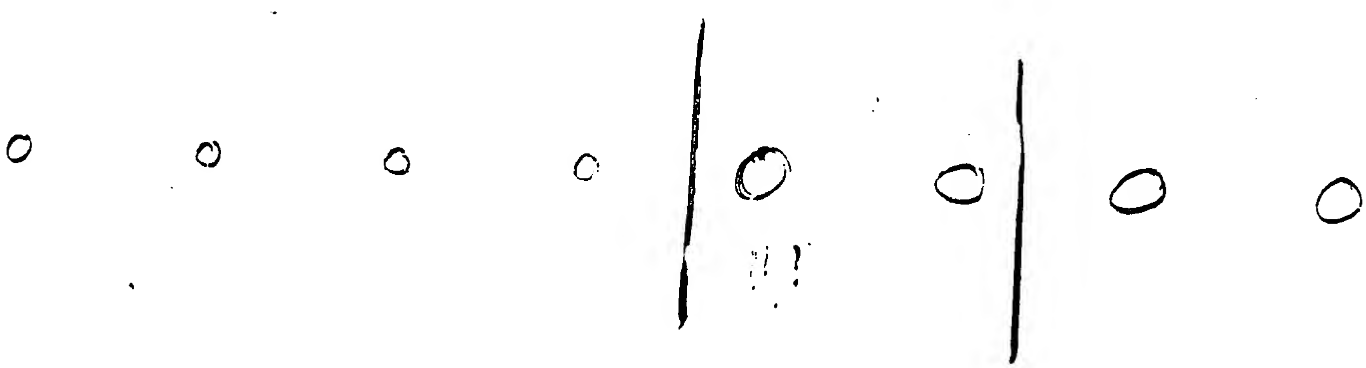
EXIBIT C
S/N 09/877,757

Polyester heat-sealable film with microperforations that are not registered in a small identifiable area in each impression. Instead, microperforations are placed along the entire length of the web, which can result in occlusion of a substantial number of the microperforations (and thus, lower the OTR) during case carton packing.



EXIBIT D
S/N 09/877,757

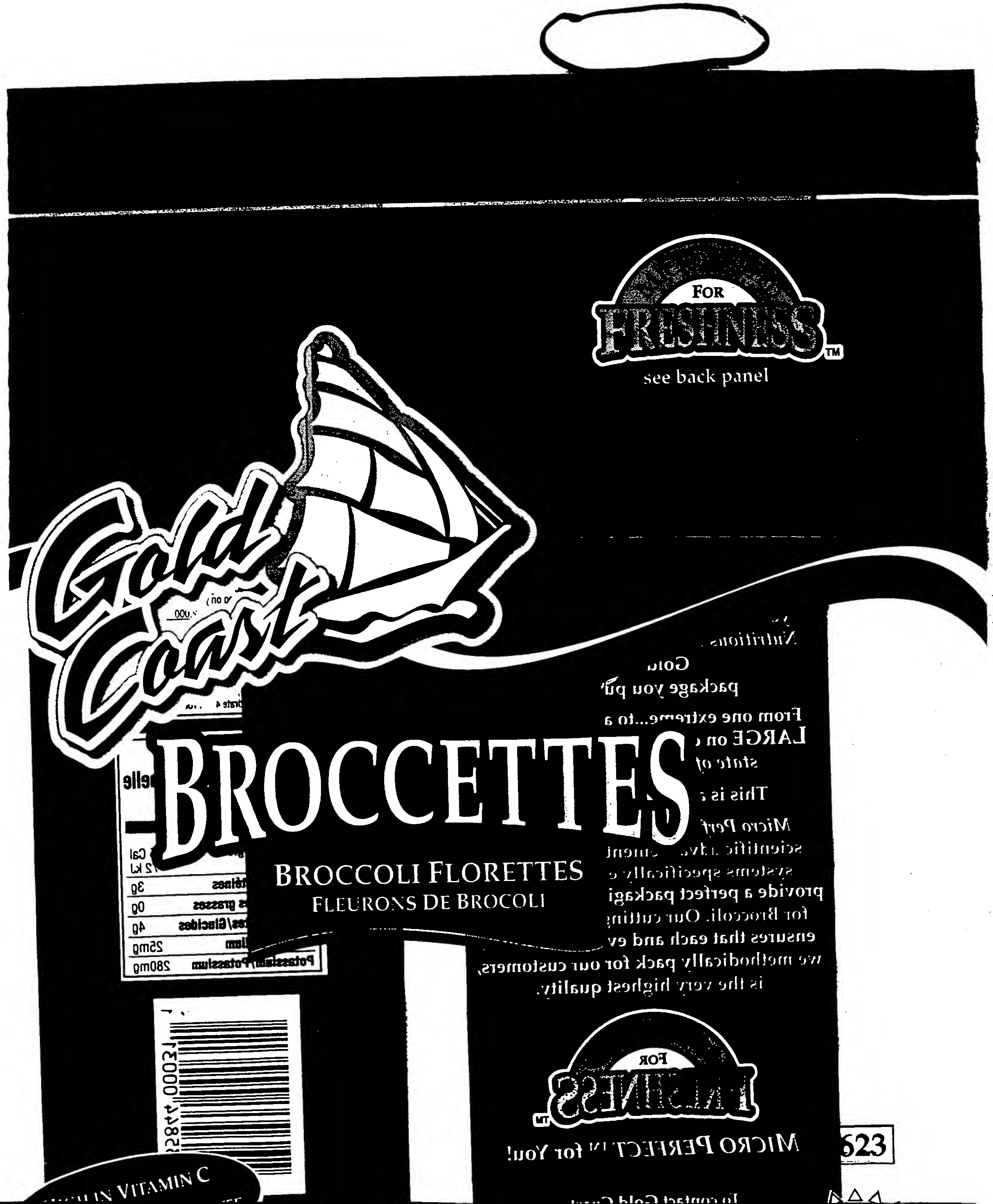
13/12



Bags made with polyethylene monoweb (2 mil PE) for fresh-cut vegetables with product-specific OTRs produced by microperforations according to Patent Application No. 09/877,757. Microperforations (circled in black) are registered in the upper quarter of the bag so they will not be occluded during case carton packing.

EXIBIT E

S/N 09/877,757


FOR FRESHNESS TM
see back panel
Gold Coast
BROCCETTES
BROCCOLI FLORETTES
FLEURONS DE BROCOLI
623

here

Gold Coast

VEGETABLE MEDLEY

MICRO PERFECT™

Are we micro-managing for perfection? Absolutely!

...and we are going to extremes to bring you the *Freshest...Safest...* and most *Nutritious* Vegetable Medley possible in every Gold Coast package you purchase.

From one extreme...to another, we are LARGE on quality and MICRO in our *state of the art* technology.

This is a *Micro Perf* Package.

Micro Perf technology is the latest scientific advancement in packaging systems specifically engineered to provide a perfect packaging environment for Vegetable Medley. Our cutting edge process ensures that each and every bag, which we methodically pack for our customers, is the very highest quality.

FOR FRESHNESS™

MICRO PERFECT™ for You!

To contact Gold Coast with your Comments or Questions or for recipe ideas:

Nutrition Facts

Serving Size 3 oz. (85g)
Servings Per Package 16

Amount Per Serving	% Daily Value*
Calories 25 Calories from Fat 0	
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 25mg	1%
Potassium 270mg	8%
Total Carbohydrate 5g	2%
Dietary Fiber 2g	10%
Sugars 3g	
Protein 2g	

Vitamin A 140% • Vitamin C 80%
Calcium 2% • Iron 2% • Folate 11%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram
Fat 9 • Carbohydrate 4 • Protein 4

Nutrition Information/ Information Nutritionnelle

Per 85g Serving
Par portion de 85g

Energy/Énergie	25 Cal 72 kJ
Protein/Protéines	2g
Fat/Matières grasses	0g
Carbohydrates/Glucides	5g
Sodium/Sodium	25mg
Potassium/Potassium	270mg

7 35844 00051 6

DISTRIBUTED BY / DISTRIBUÉS PAR
GOLD COAST PACKING, INC.

Bags for fresh-cut green beans, turnip greens, and collard greens made from 1.2 mil BOPP (biaxially oriented polypropylene film) with heat-seal coating. Microperforations (circled in black) are registered in the upper quarter of the bag so they will not be occluded during case carton packing.

EXIBIT F
S/N 09/877,757

Del Monte
Quality ®

HIGH IN VITAMIN A
HIGH IN VITAMIN C

®

Nutrition Facts
Serving Size 1 1/2 cups cho[illegible] (84g)
Servings Per Container about 5

Amount Per Serving	
Calories 20 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 35mg	1%
Total Carbohydrate 5g	2%
Dietary Fiber ***	2%
Sugars (Not available)	
Protein 1g	
Vitamin A 130% • Vitamin C 80%	
Calcium 15% • Iron 4%	

* Daily Values are based on a 2,000 [illegible]
[illegible] less than 1g.

READY TO COOK!

Freshly Cut For You

[illegible] harvest to home, Del Monte® fresh cut greens are processed locally and delivered quickly for maximum freshness. With a limited shelf life, please enjoy immediately after purchase for the best taste and maximum health benefits.

Triple Washed

Del Monte® fresh cut greens are triple washed to make them ready to cook. It is always best to wash all raw ingredients before use and to keep food preparation areas sanitized for maximum safety for your family.

Care & Handling

Del Monte [redacted] greens have specially

fruits and vegetables

EAT 5 A DAY
for [illegible] health

For recipe ide[illegible] nutritional information and produce [illegible], please visit our web site at www.freshdelmonte.com.

For questions or comments about our products or our Company,

Nutrition Facts
Serving Size: 1 cup (100g)
Servings Per Container: about 2

Amount Per Serving
Calories 25 Calories fr 12
% Da
Total Fat 0g
Saturated Fat 0
Cholesterol
Sodium 20mg
Potassium 470m
Total Carbohydra
Dietary Fiber 1g
Sugars 0g
Protein 1g
Vitamin A
Magnes

Percent Daily Valu
diet. Your daily values
depending on your calor

	Calories	
Total Fat	Less than	
Sat. Fat	Less than	
Cholesterol	Less than	30
Sodium	Less than	2
Potassium		
Total Carbohydrate		
Dietary Fiber		

INGREDIENTS
CABBAGE AND

NET WT 8 OZ (227g)

STOP & SHOP™

Fresh

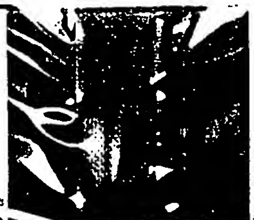
COLESLAW

Prepared for your Convenience

TESTED & APPROVED GUARANTEED!

0 21120 41414 0

· in quality
bunch greens
ound.



ıt-free, cholesterol-free
ɔaded with calcium,
n beta-carotene, high
e. Recent studies
ns help the fight

N99

Nutrition Facts
Serving Size 3 cups (108g)
Servings Per Container About 4

Amount Per Serving	
Calories 25	Calories from Fat 0
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 30mg	1%
Total Carbohydrate 5g	2%
Dietary Fiber 1g	4%
Sugars 2g	
Protein 1g	
Vitamin A 50% •	Vitamin C 30%
Calcium 2% •	Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet.

EAT 5 A DAY for better health

duct of:

NuGreens
California

s or information:
angreens.com
ЗGREENS

Cookin' with

Cut N Clean Greens

Taste and Preparation
Collard greens, with their cabbage-like flavor, are delicious and ultra-versatile. They pair well with other vegetables and with meats such as smoked turkey or salt pork. Collard greens can also be added to soups and stews, or slow-cooked in its own juices for a completely satisfying side dish.

Cut 'n Clean Greens Southern Collards
Entrée - Traditional

- 1 lb. Cut 'n Clean Greens, Collard
- 1 smoked ham hock
- 1 yellow onion, cut into quarters
- 1 turnip, cut into quarters
- 1 tbsp hot pepper vinegar
- 3 garlic cloves, chopped
- 1 tbsp season salt
- 1 tsp sugar

In a large pot, bring 4 cups of water to a boil, add ham hock, season salt, vinegar and cook covered until ham hock is tender, about 30 - 40 minutes. Sauté onion for 5 minutes, add garlic for 5 more minutes, then add sauté to the boiling water. Add Cut 'n Clean Collard Greens and cook for 40 minutes more until desired tenderness. Add sugar to taste.

Serving size: 4 oz.
Number of servings: 4

Cut 'n Clean Greens Collards and Fish Stew
Entrée - Contemporary

- 1 lb. Cut 'n Clean Greens, Collard
- 2 medium onions, large dice
- 1 green pepper, large dice
- 2 cloves garlic, minced
- 1/8 tsp crushed red pepper
- 1 tbsp cajun seasoning
- 2 tbsp dijon mustard
- 2 tbsp flour
- 3 tbsp olive oil
- 16 oz. can tomato sauce
- 2 quarts water
- 8 oz. can clam juice
- 1 lb. fish fillets of your choice
- 1/2 tsp paprika
- Salt & pepper to taste

In a medium pot, cook onions, green pepper, garlic and crushed red pepper in olive oil until mixture is tender, about 3 minutes. Add Cut 'n Clean Collard Greens and water, bring to a boil. Cover and cook for 25 minutes. Cut fish into 2" cubes, add to pot. Pour in tomato sauce, and remaining ingredients, sprinkle with paprika, salt and pepper. Reduce heat to medium. Cover and simmer until fish flakes easily with a fork, about 15 minutes. Mix flour and 1/4 cup cold water, add to thicken soup.

Serving size: 12 oz.
Number of servings: 6

Cut 'n Clean Greens Freshness and Handling
Keep refrigerated in crisper

The Fresh 1

Fresh 'n Easy

GREEN BEANS

JUDIAS VERDES (EJOTES)

GREEN BEANS

JUDIAS VERDES (EJOTES)

• WHOLE TRIMMED GREEN BEANS •

JUDIAS VERDES ENTERAS Y

NEW

Sesame Green Beans Makes 4 servings

1-12oz. package Fresh n' Easy Green Beans, washed
1 tablespoon olive oil
1 tablespoon sesame seeds
1/4 cup chicken broth
1/4 teaspoon salt freshly ground black pepper to taste

Directions:

Heat oil in a large skillet or wok over medium heat. Add sesame seeds. When seeds start to darken, stir in green beans. Cook, stirring, until the beans turn bright green. Pour in chicken broth, salt and pepper. Cover and cook until beans are tender-crisp, about 10 minutes. Uncover and cook until liquid evaporates.

Serving Suggestion
Sugerencias para Servidas

If you have questions or comments about the The Fresh 1 line of products please call 1-800-321-3123, or visit our website at *www.thefresh1.com/*

Si tiene alguna pregunta o comentario sobre la linea de productos The Fresh 1 no vacile en llamar al 1-800-321-3123, o visite nuestro sitio Web en *www.thefresh1.com*

Nutrition Facts

Serving Size 3/4 cup (83g)
Servings Per Container 4

Amount per serving	
Calories 25	Calories from Fat 0
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0g	0%
Sodium 0mg	0%
Total Carbohydrate 5g	2%
Dietary Fiber 3g	12%
Sugars 2g	
Protein 1g	

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrates		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrates 4 • Protein 4

Microwave Directions:

- Remove green beans from bag and rinse. In microwave-safe bowl, combine Fresh n' Easy Green Beans and 1/4 cup water. Loosely cover and microwave on HIGH for 5 to 8 minutes, depending on desired crispness. (*To ensure even cooking, rotate bowl halfway through cooking time.*) Drain, season and serve.

Stove Top Directions:

- Remove green beans from bag and rinse. In medium saucepan, add Fresh n' Easy Green Beans to 1 cup rapidly boiling water. Cover and cook over MEDIUM heat, stirring occasionally, for 5 to 8 minutes, depending on desired crispness. Drain, season and serve.

Instrucciones para cocimiento en microondas:

- Saque las judias verdes de la bolsa y enjuáguelas. En un tazón a prueba de microondas, combine las judias verdes Fresh n' Easy™ con 1/4 de taza de agua. Cubra parcialmente y cuézalas en el microondas en máximo (HIGH) durante 5 a 8 minutos, dependiendo de cuán crujientes se deseen. (Para asegurarse de obtener un cocimiento uniforme, gire el tazón a mitad del tiempo de cocimiento). Escúrralas, condiméntelas y sírvalas.

Instrucciones para cocimiento en estufa:

- Saque las judias verdes de la bolsa y enjuáguelas. En una cacerola

Bags made with a 7-layer coextruded polyethylene film (2.2 mil) for fresh-cut vegetables. Microperforations (circled in black) are registered in the upper quarter of the bag so they will not be occluded during case carton packing.

EXIBIT G
S/N 09/877,757

RIGERATED

lor
ms

LITY SALADS

CONSERVER RÉFRIGÉRÉ

Broccoli Florets

Fleurons de brocoli

n Facts

(71g)

iner About 19

ing	
Calories from Fat 0	
	% Daily Value*
	0%
t 0g	0%
)mg	0%
	1%
ydrate 4g	1%
2g	8%
• Vitamin C 100%	
• Iron	0%

3s are based on a 2,000
ity values may be higher
on your calorie needs:

ies:	2,000	2,500
than	65g	80g
than	20g	25g
than	300mg	300mg
than	2,400mg	2,400mg
	300g	375g
	25g	30g

Nutrition Information/ Information Nutritionnelle

Per 71 g serving (1cup)
Par portion de 71 g (1 tasse)

Energy / Énergie	14 Cal 60 kJ
Protein / Protéines	2.2 g
Fat / Matières grasses	0.3 g
Carbohydrates / Glucides	4.0 g
Sodium / Sodium	25 mg
Potassium / Potassium	260 mg

Pecentage of Recommended Daily Intake
Pourcentage de l' apport quotidien recommandé

Vitamin A / Vitamine A	3%
Vitamin C / Vitamine C	106%
Folacin / Folacine	27%
Iron / Fer	3%

Distribués par / Distributed by:

Farms, Inc.
Salinas · California 93901
Orlando · Florida 32809
Smyrna · Tennessee 37167

FRESH

BROCC(
FLORET

Keep Refrigerated 3

NET WT. 3 LBS. (1

DISTRIBUTED BY SYSCO CORPORATION

Fresh-cut apple bag made with a laminate of 0.70 mil oriented polypropylene and 1.75 mil PE. Microperforations (circled in black) are registered in the upper quarter of the bag so they will not be occluded during case carton packing.

EXIBIT H
S/N 09/877,757

Pull To Open

RECLOSABLE ZIPPER

KEEP REFRIGERATED

KEEP REFRIGERATED

Crunch Pak
Wenatchee, WA
Product of U.S.A.

SWEET

Here it is! The healthy apple snack that refreshes.

Crunch Pak® apple slices are the real thing - pure apples. Energy and fiber without fat or cholesterol!

No browning. No aftertaste. No more slicing or coring... Just open the bag and enjoy!

What you get is the natural goodness of sliced apples.

Visit us at our web site at:
www.crunchpak.com

Nutrition Facts
Serving Size: 2 oz. (57 grams)
Servings Per Container: 8

Amount per Serving	
Calories: 29 Fat Calories: 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 0mg	0%
Potassium 62mg	2%
Total Carbohydrate 8g	2%
Dietary Fiber 2g	7%
Sugars 6g	
Protein 0g	
Vitamin A 1%	Vitamin C 3%
Calcium 0%	Iron 1%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Ingredients: Fresh Apples, Calcium Ascorbate (a blend of Calcium and Vitamin C to maintain freshness and color)

Net Wt 16oz (454 grams)

4

www.crunchpak.com

NET WT. 1lb (16oz) (454g)

Heat-sealable lidding films (heat-seal coated PET base film) for fresh-cut fruit with product-specific OTR produced by microperforations according to Patent Application No. 09/877,757. Heat-sealable PET lidding films are used to create a hermetic heat seal to rigid plastic containers.

EXIBIT I
S/N 09/877,757

Ready Pac®

NO PRESERVATIVES • KEEP REFRIGERATED

NET WT. 24 oz (680g)

Ready Pac

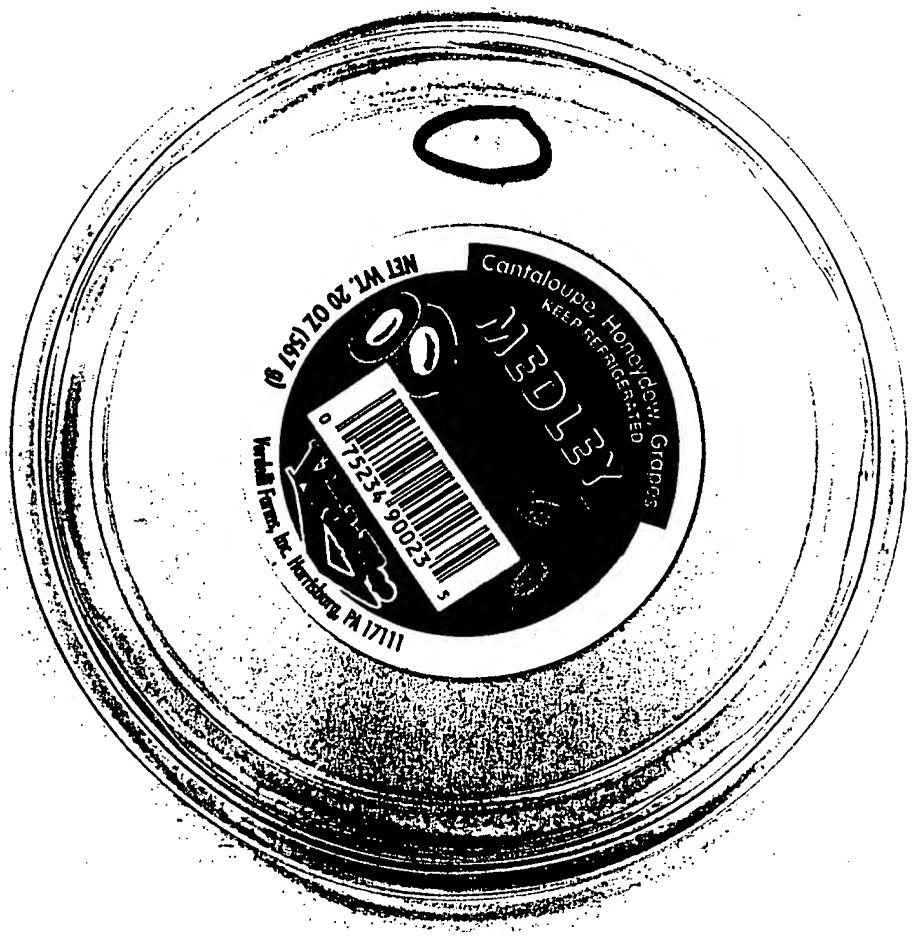
NO PRESERVATIVES • KEEP REFRIGERATED

NET WT. 12 oz (340g)

11258

A semi-rigid lid for a semi-rigid cup. The lid is microperfed (circled in black) to control the atmosphere inside the container.

EXIBIT J
S/N 09/877,757


Cantaloupe, Honeydew, Grapes
KEEP REFRIGERATED
MEDLEY
NET WT. 20 OZ (567 g)
0 75234 90023 5
Farms, Inc. Harrisburg, PA 17111